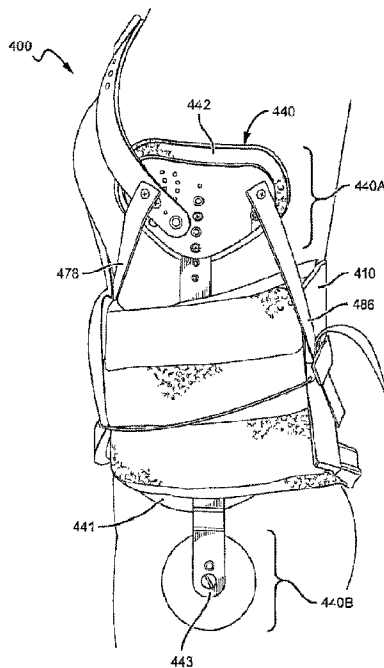




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(57) **Abrégé/Abstract:**

A scoliosis brace comprising a flexible belt (410), configured to wrap around a mid-portion of the wearer and fasten upon itself, a hip pad (443) configured to be positioned on a hip region of a lateral side of the wearer, a torso pad (442) configured to be positioned on a torso region on the lateral side of the wearer, and coupled to the hip pad by at least a first arm (440) removably attached to an inner surface of the flexible belt via a first hook and loop fastener. The brace is characterized by a first strap (478) coupling an anterior portion of the torso pad with a portion of the belt anterior to the first arm and a second strap (486) coupling a posterior portion of the torso pad with a portion of the belt posterior to the first arm, wherein the first and second straps help to secure the position of the first arm.

A scoliosis brace comprising a flexible belt (410), configured to wrap around a mid-portion of the wearer and fasten upon itself, a hip pad (443) configured to be positioned on a hip region of a lateral side of the wearer, a torso pad (442) configured to be positioned on a torso region on the lateral side of the wearer, and coupled to the hip pad by at least a first arm (440) removably attached to an inner surface of the flexible belt via a first hook and loop fastener.

The brace is characterized by a first strap (478) coupling an anterior portion of the torso pad with a portion of the belt anterior to the first arm and a second strap (486) coupling a posterior portion of the torso pad with a portion of the belt posterior to the first arm, wherein the first and second straps help to secure the position of the first arm.

SCOLIOSIS BRACE

[0001] This paragraph left intentionally blank.

Field of the Invention

[0002] The field of the invention is orthotics.

5 **Background**

[0003] The following description includes information that may be useful in understanding the present invention. It is not an admission that any of the information provided herein is prior art or relevant to the presently claimed invention, or that any publication specifically or implicitly referenced is prior art.

10 [0004] Scoliosis is a medical condition associated with an abnormally curved spine, often thought to be a progressive disease, at least until adulthood. Scoliosis can have severe adverse affects on a patient's life, both physically and physiologically. One possible method of treating or managing scoliosis is surgery. Unfortunately, scoliosis surgery can be very risky. Less
15 invasive methods of treating or managing scoliosis has traditionally included physical therapy, chiropractic therapy, or bracing, among other things.

[0005] Some previous efforts have been made to provide improved comfort, support, or customizability to individual wearers. For example, U.S. Patent No. 4,230,101 to Gold, U.S. Patent No. 5,012,798 to Graf et al., International Patent Application Publication No. WO 2010/044796 to Ogilvie et al., International Patent Application Publication No. WO
20 2006.068459 to Van Loon et al., U.S. Patent No. 5,405,313 to Albin, and UK Patent Application GB 2467974 to Mills teach various scoliosis management devices.

[0006] This paragraph left intentionally blank.

[0007] Unfortunately, none of the above references teach a brace that provides both the desired level of comfort, support and modularity to a wearer. Thus, there is still a need for improved scoliosis braces.

Summary of the Invention

5 [0008] The inventive subject matter provides apparatus, systems and methods in which a scoliosis brace is configured to provide adjustable support to a wearer. The brace preferably comprises a flexible belt configured to wrap entirely around a mid-portion of a wearer, along with various components (e.g., struts, pads, adjustment mechanisms, etc.) configured to removably couple with the flexible belt and thereby provide customizable support to different
10 portions of a wearer's body. A brace of the inventive subject matter can advantageously be configured to add a force or restrict motion in the sagittal, transverse and coronal planes. By utilizing a belt wrapped around the mid-portion of the wearer, the belt applies loading from the brace to an anterior, middle portion of the wearer.

[0008.1] In accordance with one aspect of the present invention, there is provided a brace
15 for a mid-portion of a wearer's body, the brace comprising: a) a flexible belt having a length sufficient to wrap entirely around the mid-portion of the wearer's body; and b) a vertical strut that removably attaches to an inner surface of the belt via a first hook and loop fastener at a first position such that, when the brace is worn: i) the vertical strut is positioned over a first side of the wearer's body to restrict a motion of the wearer's body along a coronal plane; ii) a
20 top end of the vertical strut is positioned above the belt and includes a first pad for positioning inferior to an underarm of the wearer's body; and iii) a bottom end of the vertical strut is positioned below the belt, and includes a second pad for positioning at a hip of the wearer's body.

[0008.2] In accordance with another aspect of the present invention, there is provided a
25 brace for wearing by a person, the brace comprising: a) a flexible belt that wraps completely around a mid-portion of the person when the belt is worn, wherein the belt comprises a first

end and a second end, and wherein the first end overlaps with and removably couples with the second end via a first hook and loop fastener; b) a vertical strut for removable coupling to an inner surface of the belt at first and second different positions, and applies a force to a first side of a body of the person and restricts a motion of the person along a coronal plane when the brace is worn; wherein, when the brace is worn, the vertical strut extends above and below the belt and includes a first pad for positioning inferior to an underarm of the person, and a second pad for positioning at a hip of the person; and a second vertical strut removably coupled to the inner surface of the belt, and including a third pad.

[0008.3] In accordance with yet another aspect of the present invention, there is provided a brace for a wearer, comprising: a) a flexible belt that wraps entirely around a waist of the wearer when the brace is worn, wherein the belt comprises a first end and a second end, and wherein the first end is configured to overlap with and removably couple with the second end via a first hook and loop fastener; b) a vertical strut that removably attaches to an inner surface of the flexible belt via the first hook and loop fastener such that the vertical strut is disposed on a right or left side of the wearer at first and second different, user selectable positions, and restricts a motion of the wearer along a coronal plane when the brace is worn; wherein the vertical strut comprises a first pad positioned above the belt for positioning inferior to an underarm of the wearer, a second pad positioned below the belt for positioning at a hip of the wearer, a curved arm and a de-rotation pad coupled to the first pad; wherein the curved arm at least partially wraps around an upper chest portion of the wearer; and wherein the de-rotation pad restricts a forward motion of the wearer along a sagittal plane.

[0008.4] In accordance with a further aspect of the present invention, there is provided a brace comprising: a) a flexible belt that wraps around an entire mid-portion of a wearer when the brace is worn; b) a first lateral strut comprising lower and upper pads disposed at opposite ends of the first lateral strut, and a base pad positioned between the lower and upper pads; wherein: an outer surface of the base pad comprises a first fastener; an inner surface of the flexible belt comprises a second fastener; the first lateral strut removably couples with the inner surface of the flexible belt at a first position via the first and second fasteners; the lateral

strut removably couples with the inner surface of the flexible belt at a second position; and the first lateral strut extends above and below the belt along a first side of the wearer.

[0008.5] In accordance with yet a further aspect of the present invention, there is provided a scoliosis brace for a wearer, comprising: a) left and right lateral struts, each removably
5 coupled to left and right sides of a belt via first and second hook and loop fasteners, respectively, such that the left lateral strut is disposed along a left side of the wearer at a first user-selectable position and the right lateral strut is disposed along a right side of the wearer at a second user-selectable position; wherein the belt wraps entirely around a waist of the wearer when the brace is worn, wherein the left and right lateral struts are each coupled to an inner
10 surface of the belt via the first and second hook and loop fasteners, respectively, and wherein the belt supports the left and right lateral struts; and wherein at least one of the left and right lateral struts extends above and below the belt to define a top and bottom portion of the strut, and includes an upper pad at the top portion, and a hip pad at the bottom portion for positioning at a hip of the wearer when the brace is worn.

[0008.6] In accordance with one aspect of the present invention, there is provided a scoliosis brace configured to provide adjustable support to a wearer, comprising:

a flexible belt configured to wrap around a mid-portion of the wearer and fasten upon itself;

a hip pad configured to be positioned on a hip region of a lateral side of the wearer; a
20 torso pad configured to be positioned on a torso region on the lateral side of the wearer, and coupled to the hip pad by at least a first arm; and

a first strap coupling an anterior portion of the torso pad with a portion of the flexible belt anterior to the first arm and a second strap coupling a posterior portion of the torso pad with a portion of the flexible belt posterior to the first arm, wherein the first and second straps
25 helps to secure the position of the first arm, and wherein the first arm removably attaches to an inner surface of the flexible belt via a first hook and loop fastener at a first position.

[0009] In one aspect of the inventive subject matter, a scoliosis brace comprises a first vertical strut having an anchor pad (or base pad), and that is removably coupled to the belt,

preferably on the belt's interior side (*i.e.*, the side facing toward the wearer). It is contemplated that the anchor pad or the strut can removably attach to the belt in any commercially suitable manner, including for example, via a hook and loop fastener, snaps, buttons, magnets, and threading. The brace could include one or more vertical struts depending on the wearer's
5 needs. Each of the struts could include one or more pieces without departing from the scope of the invention described herein. For example, the first strut could comprise two struts that are coupled together to form a single strut, or could instead comprise a unitary structure.

[0010] As used herein, a "vertical strut" is defined broadly to include a plurality of
10 components (pads, struts, angle or height adjustment mechanisms, etc.) that are coupled with one another to create a single piece. As used herein, a "strut" is a single rod or bar forming a part of a framework. It can generally be preferred that a strut is made from either (1) a rigid material (e.g., a metal, a hard plastic, etc.) that requires more than an average person's force

to bend, or (2) a material (e.g., aluminum, etc.) that is sized and dimensioned to be pliable when a strong force is applied, but sturdy when an ordinary force is applied.

5 [0011] In some embodiments, the first strut can include a thoracic pad at a first end portion such that the thoracic pad can provide a pressure to a first side of the wearer below the underarm. It is contemplated that the first strut can be composed of one or more pieces and could be configured to allow for adjustment of a height of the first strut to increase a distance between the belt and the thoracic pad. Where the first strut comprises two or more pieces, it is contemplated that the pieces could be movably coupled to one another such that one can rotate or pivot relative to the other.

10 [0012] A distance of the thoracic pad relative to the central point of the anchor pad can be adjusted via any commercially suitable height adjustment mechanism, including for example, a rack and pinion mechanism, a biasing mechanism, a slidably coupled telescoped component, or any other commercially suitable component. Similar mechanisms can also be provided to adjust a horizontal position of the thoracic pad relative to the central point of the anchor pad.

15 [0013] A brace of the inventive subject matter can also comprise a first hip pad coupled to the first strut, and configured to provide support to a hip area of a wearer. It is contemplated that the first strut could include a height adjustment mechanism (e.g., to adjust a distance of the hip pad relative to the belt or an angle adjustment mechanism (e.g., to adjust a horizontal or vertical position of the hip pad on the wearer relative to the belt).

20 [0014] In another aspect of the inventive subject matter, it is contemplated that the thoracic pad can be coupled to a curved arm configured to at least partially wrap around an upper chest portion of a wearer. The curved arm is preferably coupled to a de-rotation pad that is configured to put pressure on the upper chest wall on one side to cause a force intended to resist forward motion and rotation of that side of the chest when the brace is worn.

25 [0015] One or more straps can be provided and configured to couple with two or more components of the brace. For example, a first strap can be coupled to the belt (e.g., via hook and loop fastener, snaps, buttons, threading, zipper, or other commercially suitable fastener(s) or combinations thereof) and the thoracic pad (e.g., via a carabiner, a buckle, a button, a snap, or other commercially suitable fastener(s) or combinations thereof). A second strap can be

configured to couple to at least two of the following, among other components: the de-rotation pad, the rounded arm, the first strut, the anchor pad, or the hip pad.

[0016] In some embodiments, a first vertical strut comprising the anchor pad, first strut, thoracic pad, de-rotation pad or hip pad can be coupled to the belt such that it provides support predominantly to a left or right side of the wearer. As used herein, the term “provides support predominantly to a left or right side” means that at least 80% of the components are located on a single side of the wearer. Thus, it is contemplated that the first vertical strut can be coupled to the belt such that the belt supports the first vertical strut, while the strut provides support predominantly to a left side of the wearer, even though 20% or less of the support is provided to the right side of the wearer. In some preferred embodiments, at least 90%, at least 95%, or even 100% of the support can be provided to a single side of the wearer via the first vertical strut. It is contemplated that a second vertical strut having one or more components can be provided, if needed, that is coupled to the belt such that the second vertical strut is disposed, and thereby provides support predominantly to, the opposite side of the wearer.

[0017] The additional components can include, for example a second anchor pad, a second thoracic pad, and/or, a second hip pad. The additional components could further include a second de-rotation pad coupled to the second thoracic pad via a second rounded arm and/or any other suitable component(s).

[0018] Alternatively or additionally to being movably coupled to one another, each of the struts, straps, and pads can be removably coupled with, or attached to, another strut, pad, belt or other component of the inventive subject matter. Where a strut, pad or other component is moved from a first location to a second location, it is contemplated that the locations can be completely distinct or partially overlapping. For example, it is contemplated that a strut, pad or other component can be moved by as little as 5 cm, 2 cm, or even 1 cm or less, or can be moved by as much as 6 cm, 10 cm, or even 20 cm or even more.

[0019] Various objects, features, aspects and advantages of the inventive subject matter will become more apparent from the following detailed description of preferred embodiments, along with the accompanying drawing figures in which like numerals represent like components.

Brief Description of the Drawings

[0020] Fig. 1 shows one embodiment of a vertical strut of the inventive subject matter.

[0021] Fig. 2 shows one embodiment of a thoracic pad, rounded arm and de-rotation pad of the inventive subject matter.

5 [0022] Fig. 3 shows one embodiment of another vertical strut of the inventive subject matter.

[0023] Fig. 4 shows one embodiment of a first and second vertical strut coupled to a flexible belt.

[0024] Fig. 5 shows one embodiment of a brace of the inventive subject matter as worn by a wearer.

10 [0025] Fig. 6 shows one embodiment of a strap of the inventive subject matter having a buckle.

[0026] Fig. 7 shows one embodiment of a rear portion of a brace of the inventive subject matter.

15 [0027] Fig. 8 shows one embodiment of a side portion of a brace of the inventive subject matter.

[0028] Fig. 9 shows a step by step flowchart of one method of fitting a wearer with a brace of the inventive subject matter.

[0029] Fig. 10 shows another embodiment of a brace of the inventive subject matter having substantially similar left and right vertical struts with removable and adjustable components.

20 **Detailed Description**

[0030] The following discussion provides many example embodiments of the inventive subject matter. Although each embodiment represents a single combination of inventive elements, the inventive subject matter is considered to include all possible combinations of the disclosed elements. Thus if one embodiment comprises elements A, B, and C, and a
25 second embodiment comprises elements B and D, then the inventive subject matter is also considered to include other remaining combinations of A, B, C, or D, even if not explicitly disclosed.

[0031] It is contemplated that a brace of the inventive subject matter can utilize one or more of the components discussed in co-owned U.S. Patent Nos. 7,001,348 and 8,142,377, and U.S. Patent Application Publication Nos. 2012/0232450 and 2012/0245502. For example, it is contemplated that a brace can utilize a pulley system as disclosed in U.S. Patent No.

5 7,001,348.

[0032] **Figure 1** shows a vertical strut 100 of the inventive subject matter. Vertical strut 100 is configured to provide support to a right or left side of a wearer, and preferably comprises an anchor pad 170 coupled with strut 190, a hip pad 180, and a thoracic pad 140. It is contemplated that the a rounded arm 130 and a de-rotation pad 120 having a buckle receiver 110 can be coupled to the vertical strut depending on the needs of the wearer.

[0033] Anchor pad 170 comprises a hook or loop fastener 171 that is configured to removably attach to a belt (not shown). Contemplated pads can comprise any commercially suitable material(s), including for example, foam, silicon, nylon, cotton, mesh, or any other suitable material.

15 [0034] In some contemplated embodiments, strut 190 can be coupled to angle/height adjustment mechanism 150 that allows a user to adjust a horizontal or vertical location (i.e., a distance) of thoracic pad 140 relative to the anchor pad 170. One embodiment of such an angle/height adjustment mechanism is a second piece 162 that couples to the strut 190 via a screw mechanism 161. In such embodiment, the horizontal location of thoracic pad 140
20 relative to anchor pad 170 can be adjusted via adjustment mechanism 150 by simply rotating the second piece 162 relative to the first strut 190. The vertical height of thoracic pad 140 relative to anchor pad 170 can be adjusted via adjustment mechanism 150 by unscrewing screw 161, adjusting the alignment of perforations on the first strut 190 and second piece 162, and re-tightening screw 161.

25 [0035] First strut can thereby apply pressure above and below a wearer's mid-line via the upper thoracic pad 140 and lower hip pad 180, each of which is coupled to the first strut 190. By coupling the first strut 190 to a support belt that extends around a mid-portion of the wearer, the belt applies loading to each end of the first strut 190 and second piece 162 where used. In addition, the first strut 190 can be supported by the belt, such that the vertical strut
30 100 and brace is dependent on the belt. In some contemplated embodiments, the belt can

include a pad disposed at the wearer's pubic region such that the pad counteracts the forces applied to the left and/or right side of the wearer.

5 [0036] In other contemplated embodiments, other angle or height adjustment mechanisms can be used, including for example, a series of snaps, a rack and pinion mechanism, a biasing mechanism, a slidably coupled telescoped component, or any other commercially suitable mechanisms.

10 [0037] Optionally, a curved arm 130 can be coupled to second piece 162 or first strut 190 preferably via an angle/height adjustment mechanism 160. Curved arm 130 is coupled with de-rotation pad 120, which advantageously provides support to an upper chest region of a wearer, and is configured to at least partially prevent a rotation of a patient's torso when worn, for example, by preventing a rotation of one or more components of the brace with respect to another component.

15 [0038] **Figure 2** is a close up view of a thoracic pad 260, curved arm 215 and de-rotation pad 210 of a vertical strut 200 of the inventive subject matter. Strut 280 is coupled to thoracic pad 260 via a fastener that can also act as a height adjustment mechanism 270. However, other types of fasteners could be used, and it is contemplated that strut 280 could lack a height adjustment mechanism. Thoracic pad 260 is further coupled to curved arm 215, which can also act as a part of height and angle adjustment mechanism 240 in conjunction with one or more fasteners 216. It is contemplated that a user can remove or loosen fasteners 216 and
20 realign the perforations of curved arm 215 with a suitable perforation of thoracic pad 260 in order to adjust an angle or height of de-rotation pad 210 relative to thoracic pad 260.

[0039] Although thoracic pad 260 is shown including a metal structure that holds padding in place, it is contemplated that the structure and thoracic pad could be distinct pieces coupled together to form thoracic pad 260.

25 [0040] De-rotation pad 210 can be coupled to curved arm 215 in any commercially suitable manner. However, it is currently preferred that de-rotation pad 210 and curved arm 215 are coupled together via a series of perforations and a snap configured to lock de-rotation pad 210 in a position aligned with one of the perforations.

30 [0041] De-rotation pad 210's fastener (height adjustment mechanism 220) is coupled to buckle receiver 250, which is configured to receive a buckle of a strap (not shown). A strap

can be advantageously used to block a rotation of a component of the brace with respect to another component of the brace or providing a tension or tautness between the components to which it is attached. For example, a strap that is coupled to buckle receiver 250 and the belt can advantageously be used to block a change in a vertical position of a de-rotation pad relative to the belt, and further block a rotation of the vertical strut 200 comprising the de-rotation pad relative to the belt (alternatively or additionally to the blocking provided by a fastening mechanism between the belt and vertical strut).

[0042] Figure 3 shows another embodiment of a vertical strut 300 of the inventive subject matter. Vertical strut 300 comprises an anchor pad 310, thoracic pad 320 and an optional adjustment mechanism 325 that allows for angular and height adjustment of the thoracic pad 320 relative to the anchor pad 310. The vertical strut can include first and second struts 316 and 317, respectively, although a single strut could alternatively be used. It is contemplated that vertical strut 300 could also include additional components that are removable and adjustable with respect to the anchor pad 310 and thoracic pad 320. For example, vertical strut 300 could comprise a third strut coupled with a hip pad that extends below the anchor pad 310 in a direction opposite that of the thoracic pad. Alternatively, the hip pad could be coupled to a single strut that extends above and below the anchor pad.

[0043] It is contemplated that vertical strut 100 or 200 could be worn on a right side of a wearer while vertical strut 300 is worn on a left side of a wearer, or vice versa. In such embodiments, loading can be applied to the left and right side of the wearer simultaneously by coupling a vertical strut to the belt such that each strut aligns with an opposing side of the wearer.

[0044] Figure 4 shows a first vertical strut 440 and second vertical strut 460 each removably coupled to a belt 410 that wraps around a mid-line of wearer. Belt 410 can include hook or loop fastener 420 on an inner side 422, and a complementary hook or loop fastener 430 on an outer side 425, which allows the belt to fasten to itself in some embodiments. Of course any commercially suitable fastener(s) could be used to couple the belt 410 to the wearer. Brace 400 also comprises a first vertical strut 440 removably attached to a left side of belt 400, and a second vertical strut 460 removably attached to a right side of belt 400. Preferably, each of the first and second vertical struts is coupled to an inner side of the belt – i.e., the surface of the belt facing toward the wearer when worn.

5 [0045] Belt 410 is preferably configured to wrap entirely around a mid-portion of a wearer and securely fasten to itself via hook or loop fasteners 420 and 430, although any commercially suitable fasteners could be used. In this manner, belt 410 can be used to support one or more vertical struts coupled to the belt. In some embodiments, the vertical struts can be coupled solely to the belt and thereby entirely supported by the belt 410 disposed about a mid-portion of the wearer.

10 [0046] Depending on the wearer's needs, in some contemplated embodiments, brace 400 can include a first strap 470 coupled to the belt 410 at a first attachment point (on outer side 425), and configured to couple with a thoracic pad of second vertical strut 460, and de-rotation pad 450 of first vertical strut 440 via buckle receiver 455. First strap 470 and de-rotation pad 450 can be advantageously used together to cause an increase in pressure on a portion of the patient to support them in a desired position.

15 [0047] One having ordinary skill in the art should appreciate that references to a "fastener" are used broadly to refer to any commercially suitable fastener(s), including for example, a hook and loop fastener, a button, a snap, a belt type buckle, a side squeeze buckle, a magnet, a zipper, perforations and screws or snaps, or any other commercially suitable fastener(s). One having ordinary skill in the art should also appreciate that some fasteners can also serve as, or be coupled with, an adjustment mechanism such as a length, height, angle or other adjustment mechanism.

20 [0048] Figure 5 shows the brace 400 of Figure 4 as partially fastened to a wearer. As shown, belt 410 is fastened to itself around the mid-portion of the wearer via hook and loop fasteners, and the brace 400 can be tightened via a first cord system 475 and a second cord system 476, although a single cord system could be used. It is contemplated that the pull tabs of cord systems 475 and 476 (e.g., 475A and 476A) can comprise a hook or loop fastener that can
25 removably attach to a hook or loop fastener of the outer side of belt 400. As discussed above, it is contemplated that a brace of the inventive subject matter can utilize one or more of the components discussed in co-owned U.S. Patent Nos. 7,001,348 and 8,142,377, and U.S. Patent Application Publication Nos. 2012/0232450 and 2012/0245502. For example, it is contemplated that a brace can utilize a pulley system as disclosed in U.S. Patent No.
30 7,001,348.

[0049] Brace 400 can optionally comprise a second strap 478, which is fastened to an outer side of belt 400 via any suitable fastener (e.g., hook or loop, snaps, buttons, etc.) and further coupled to a thoracic pad of first vertical strut 440.

5 [0050] **Figure 6** shows a front-left side view of the brace 400 of Figures 4 and 5. First strap 470 is attached to belt 410 and second vertical strut 460, and is shown in being fastened to buckle receiver 455 of de-rotation pad 450 via buckle 471 of first strap 470. Second strap 478 is removably fastened to belt 410 and removably fastened to the thoracic pad of first vertical strut 440 via a screw that also acts as part of an angle and height adjustment mechanism between the curved arm and thoracic pad of first vertical strut 440.

10 [0051] **Figure 7** shows a back view of the brace 400 shown in Figure 4 as worn by a wearer. Brace 400 comprises a tightening mechanism 480 shown in having two cord systems 475 and 476. It is contemplated that first cord system 475 can be configured to tighten a top portion of belt 410 (e.g., shorten a distance between the top portion of right cord guide cover 482 and left cord guide cover 484) when pulled in a first direction, while second cord system 476 can be configured to tighten a bottom portion of belt 410 (e.g., shorten a distance between the bottom portion of right cord guide cover 482 and left cord guide cover 484) when pulled in a second direction different from the first direction. Alternatively, each cord could be used to tighten a top and a bottom portion of belt 410.

15 [0052] Brace 400 further comprises a third strap 486 and fourth strap 488. Third strap 486 is configured to attach to left cord guide cover 484 and first vertical strut 440 via any suitable fastening means, and fourth strap 488 is configured to attach to right cord guide cover 482 and second vertical strut 460 via any suitable fastening means.

20 [0053] The combination of first, second, third and fourth straps (470, 478, 486, and 488) can be used together to provide increased support to a wearer while ensuring that a proper amount of force is being applied to the areas intended.

25 [0054] **Figure 8** is a left side view of the brace 400 of Figures 4-7 showing first vertical strut 440 coupled to an inner side of belt 410 that extends about a mid-portion of the wearer. As shown, anchor pad 441 is substantially aligned with the mid-portion of the wearer. Vertical strut 440 is configured to provide pressure to at least two portions of the wearer's body (e.g., upper and lower portions). The first area 440A (upper portion) is the left side of the wearer between the underarm and mid-portion, which is supported by thoracic pad 442. The second

area 440B (lower portion) is the left hip of the wearer, which is supported by hip pad 443. In such embodiment, the vertical strut 440 is dependent on and supported by the belt 410, and loading is applied to the upper and lower portions of the wearer's body.

5 [0055] Optionally, second strap 478 and third strap 486 can be fastened to belt 410 and thoracic pad 442, and are configured to provide an adjustable amount of tension or tautness between the two components to which they are attached, or prevent a rotation of one component (e.g., the thoracic pad 442) relative to another component (e.g., the midline of the belt where the belt could be folded in half along its length) to thereby prevent a rotation of a patient's body, or adjust the patient's body back into a less rotated state.

10 [0056] **Figure 9** provides a step by step flowchart of one method of fitting a wearer with a brace.

[0057] As shown in step 1, a healthcare professional or other person can obtain an x-ray of a wearer's spine to identify a curve apex and locations where force should be applied. For example, step 1 shows that force should be applied at points A, B and C.

15 [0058] Step 2 shows how to locate an anchor point to which the anchor pad can be aligned (i.e., a mid-portion of the wearer). The left anchor point, for example, is located between the rib cage and iliac crest of the wearer. Depending on the curvature of the wearer's spine or other factors, it is contemplated that the anchor point(s) can alternatively be in a location other than between the rib cage and iliac crest.

20 [0059] Step 3 shows a vertical strut being fit on a wearer based on the anchor pad's alignment with the left anchor point. Once the location of the anchor pad is determined, the remaining components of the vertical strut can be adjusted (e.g., bending of the strut, adjustment of the relative heights of each component, adjustment of an angle between components, etc.) to provided a force to the intended areas of a user (e.g., areas A and C of
25 step 1) as shown in Steps 4 and 5.

[0060] Step 4 shows a possible arrangement of components of a vertical strut, although some of the components may not be used. Step 5 shows that the thoracic pad of the first vertical strut can align with force point A. In this embodiment, it is generally preferred that at least two inches separate the underarm of the wearer and the top portion of the thoracic pad. In this

area 440B (lower portion) is the left hip of the wearer, which is supported by hip pad 443. In such embodiment, the vertical strut 440 is dependent on and supported by the belt 410, and loading is applied to the upper and lower portions of the wearer's body.

[0055] Optionally, second strap 478 and third strap 486 can be fastened to belt 410 and thoracic pad 442, and are configured to provide an adjustable amount of tension or tautness between the two components to which they are attached, or prevent a rotation of one component (e.g., the thoracic pad 442) relative to another component (e.g., the midline of the belt where the belt could be folded in half along its length) to thereby prevent a rotation of a patient's body, or adjust the patient's body back into a less rotated state.

10 [0056] **Figure 9** provides a step by step flowchart of one method of fitting a wearer with a brace.

[0057] As shown in step 1, a healthcare professional or other person can obtain an x-ray of a wearer's spine to identify a curve apex and locations where force should be applied. For example, step 1 shows that force should be applied at points A, B and C.

15 [0058] Step 2 shows how to locate an anchor point to which the anchor pad can be aligned (i.e., a mid-portion of the wearer). The left anchor point, for example, is located between the rib cage and iliac crest of the wearer shown located between the arrows. Depending on the curvature of the wearer's spine or other factors, it is contemplated that the anchor point(s) can alternatively be in a location other than between the rib cage and iliac crest.

20 [0059] Step 3 shows a vertical strut being fit on a wearer based on the anchor pad's alignment with the left anchor point shown located between the arrows. Once the location of the anchor pad is determined, the remaining components of the vertical strut can be adjusted (e.g., bending of the strut, adjustment of the relative heights of each component, adjustment of an angle between components, etc.) to provided a force to the intended areas of a user (e.g., areas
25 A and C of step 1) as shown in Steps 4 and 5.

[0060] Step 4 shows a possible arrangement of components of a vertical strut, although some of the components may not be used. The components may include a thoracic pad 1, an anchor pad 2, a hip pad 3, a de-rotation pad 4, a height adjuster 5, an angle adjuster 6, and an angle adjuster 7. Step 5 shows that the thoracic pad of the first vertical strut can align with force point A and the hip pad can align with force point C. In this embodiment, it is generally preferred that at least two inches separate the underarm of the wearer and the top portion of the thoracic pad. In this embodiment, a Phillips screw driver can be used to align the thoracic and hip pads with previously identified locations where force will be applied.

[0061] Step 6 shows a second vertical strut being fit on the wearer based on a second anchor pad's alignment with the right anchor point. The thoracic pad of the second vertical strut is applied to force point B identified in step 1, which represents a curve apex of the wearer's spine on an opposite side of the wearer's body from force points A and C.

[0062] In step 7, a de-rotation pad can be optionally coupled to the first vertical strut and adjusted to fit the wearer. In this embodiment, the top edge of de-rotation pad is adjusted to be 1 inch minimum below the clavicle of the wearer and directly above the nipple, as shown in Step 8. The de-rotation pad can be coupled to a curved arm or strut, which in this embodiment comprises bendable aluminum. This curved arm or strut can serve as an additional angle adjustment mechanism.

[0063] Once the first and second vertical struts have been adjusted to fit the wearer's body, a measurement can be taken between the wearer's left mid-line D and the wearer's right mid-line E as shown in Step 9.

[0064] Each of the first and second vertical struts can comprise a hook or loop fastener that is configured to removably fasten with a hook or loop fastener of either an inner or outer side of the belt (inner side shown here) as shown in Step 10. The center line of the belt should first be identified, and either strut should be attached on opposing sides of the center line such that a distance F between the midlines of each anchor pad equals the distance between the left mid-line D and the right mid-line E previously measured in accordance with Step 9.

[0065] Step 11 shows a wearer putting on the brace after the first and second vertical struts have been fit and attached to the belt in accordance with Steps 1-10. The wearer aligns the anchor pads of each strut with the left or right anchor points and wraps the belt such that the ends of the belt overlap and fasten to one another. As shown in Step 12, the first ends of the first and second anterior tension straps are then attached to the belt. A mid portion of the first tension strap is then attached to the second vertical struts thoracic pad, and a second end of the first tension strap is coupled with de-rotation pad via a buckle. The second end of the second tension strap is attached to the thoracic pad of the first vertical strut via a screw mechanism.

[0066] Step 13 shows third and fourth posterior tension straps each attached to the belt and a different component of the brace. Step 14 shows the wearer tightening the brace through first and second cord systems that are pulled in opposite directions and fastened to the belt via pull tabs.

[0067] It is contemplated that a brace of the inventive subject matter can alternatively or additionally comprise other components, including for example, a lumbar pad, an underarm support, or a chest support pad.

[0068] **Figure 10** shows another brace 500 of the inventive subject matter having substantially similar left and right vertical struts with removable and adjustable components. Brace 500 comprises a belt 510 that extends about a mid-portion of a wearer, and to which left and right vertical struts 555 and 560 can be coupled. The first vertical strut 555 comprises a first anchor pad 551, a first thoracic pad 552, and a first hip pad 554, all coupled to the first vertical strut. The second vertical strut 560 comprises a second anchor pad 561, a second thoracic pad 562, and a second hip pad 564, all coupled to the second vertical strut 560.

[0069] Optionally, the brace 500 can include a first tension strap 520, second tension strap 530, third tension strap 540, and a fourth tension strap 550.

[0070] In some embodiments, the first vertical strut 555 can include a second strut (e.g., 553) and a third strut, which are removably and adjustably coupled with a first strut such that an

angle or vertical position of the first thoracic pad and first hip pad can be adjusted relative to the first anchor pad, or even removed. Similarly, the second vertical strut 560 can include a fifth strut (e.g., 563) and a sixth strut, which are removably and adjustably coupled with a third strut such that an angle or vertical position of the second thoracic pad and second hip pad
5 can be adjusted.

[0071] Each of the first and second thoracic pads can optionally be coupled with a rounded arm, 570 and 575, which are in turn coupled with de-rotation pads, 580 and 585. The first and second straps can be removably attached to the front portion of belt 510 and a thoracic pad, while the third and fourth straps can be removably attached to the back portion of belt 510 and
10 a thoracic pad. When the brace is worn, the tension straps can both block a rotation of a component of the brace relative to other components and provide increased tension or tautness between components of the brace.

5 [0072] As used herein, and unless the context dictates otherwise, the term "coupled to" is intended to include both direct coupling (in which two elements that are coupled to each other contact each other) and indirect coupling (in which at least one additional element is located between the two elements). Therefore, the terms "coupled to" and "coupled with" are used synonymously.

10 [0073] In some embodiments, the numbers expressing quantities of ingredients, properties such as concentration, reaction conditions, and so forth, used to describe and claim certain embodiments of the invention are to be understood as being modified in some instances by the term "about." Accordingly, in some embodiments, the numerical parameters set forth in the written description and attached claims are approximations that can vary depending upon the desired properties sought to be obtained by a particular embodiment. In some
15 embodiments, the numerical parameters should be construed in light of the number of reported significant digits and by applying ordinary rounding techniques. Notwithstanding that the numerical ranges and parameters setting forth the broad scope of some embodiments of the invention are approximations, the numerical values set forth in the specific examples are reported as precisely as practicable. The numerical values presented in some
embodiments of the invention may contain certain errors necessarily resulting from the standard deviation found in their respective testing measurements.

20 [0074] As used in the description herein and throughout the claims that follow, the meaning of "a," "an," and "the" includes plural reference unless the context clearly dictates otherwise. Also, as used in the description herein, the meaning of "in" includes "in" and "on" unless the context clearly dictates otherwise.

25 [0075] The recitation of ranges of values herein is merely intended to serve as a shorthand method of referring individually to each separate value falling within the range. Unless otherwise indicated herein, each individual value is incorporated into the specification as if it were individually recited herein. All methods described herein can be performed in any suitable order unless otherwise indicated herein or otherwise clearly contradicted by context. The use of any and all examples, or exemplary language (e.g. "such as") provided with
30 respect to certain embodiments herein is intended merely to better illuminate the invention and does not pose a limitation on the scope of the invention otherwise claimed. No language in the specification should be construed as indicating any non-claimed element essential to the practice of the invention.

[0076] Groupings of alternative elements or embodiments of the invention disclosed herein are not to be construed as limitations. Each group member can be referred to and claimed individually or in any combination with other members of the group or other elements found herein. One or more members of a group can be included in, or deleted from, a group for reasons of convenience and/or patentability. When any such inclusion or deletion occurs, the specification is herein deemed to contain the group as modified thus fulfilling the written description of all Markush groups used in the appended claims.

[0077] It should be apparent to those skilled in the art that many more modifications besides those already described are possible without departing from the inventive concepts herein.

10 The scope of the claims should not be limited by the preferred embodiments set forth in the examples, but should be given the broadest interpretation consistent with the description as a whole. Moreover, in interpreting both the specification and the claims, all terms should be interpreted in the broadest possible manner consistent with the context. In particular, the terms "comprises" and "comprising" should be interpreted as referring to elements, components, or steps in a non-exclusive manner, indicating that the referenced elements, components, or steps may be present, or utilized, or combined with other elements, components, or steps that are not expressly referenced. Where the specification claims refers to at least one of something selected from the group consisting of A, B, C and N, the text should be interpreted as requiring only one element from the group, not A plus N, or B plus N, etc.

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Claims:

1. A scoliosis brace configured to provide adjustable support to a wearer, comprising:

a flexible belt configured to wrap around a mid-portion of the wearer and fasten upon itself;

a hip pad configured to be positioned on a hip region of a lateral side of the wearer; a torso pad configured to be positioned on a torso region on the lateral side of the wearer, and coupled to the hip pad by at least a first arm; and

a first strap coupling an anterior portion of the torso pad with a portion of the flexible belt anterior to the first arm and a second strap coupling a posterior portion of the torso pad with a portion of the flexible belt posterior to the first arm, wherein the first and second straps helps to secure the position of the first arm, and wherein the first arm removably attaches to an inner surface of the flexible belt via a first hook and loop fastener at a first position.

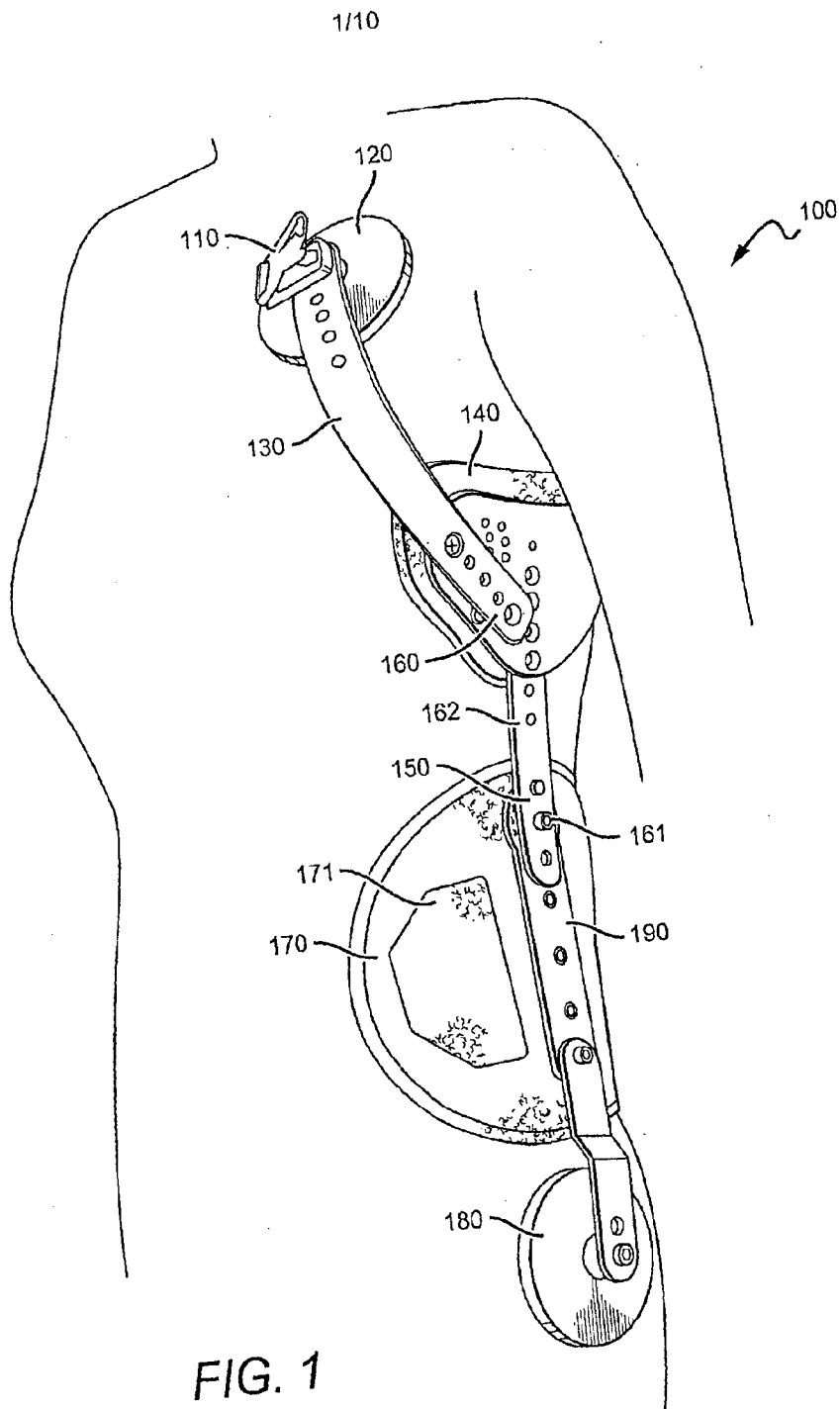
2. The brace of claim 1, wherein the torso pad is positioned to restrict a forward motion of the wearer along a sagittal plane, and the hip pad is positioned to restrict motion of the wearer along a transverse plane when the brace is worn.

3. The brace of claim 1, further comprising a de-rotation chest pad positioned medially and superiorly to the torso pad by a second arm extending from the torso pad.

4. The brace of claim 3, wherein the de-rotation chest pad is further coupled to the flexible belt by a cross torso strap.

5. The brace of claim 1, wherein the first arm comprises a height adjustment mechanism configured to allow a user to adjust a distance between the torso pad and the hip pad.

6. The brace of claim 3, wherein the second arm comprises a height adjustment mechanism configured to allow a user to adjust a distance between the derotation chest pad and the torso pad.



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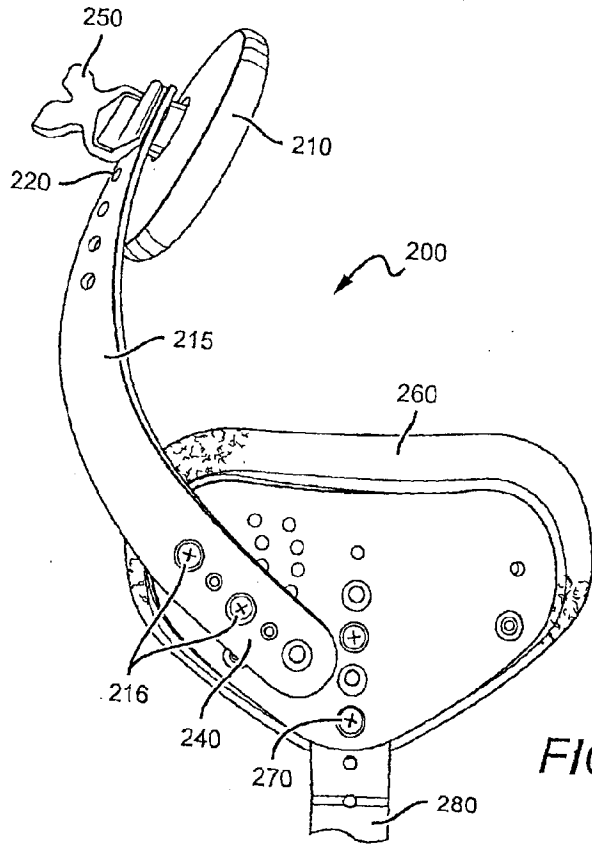
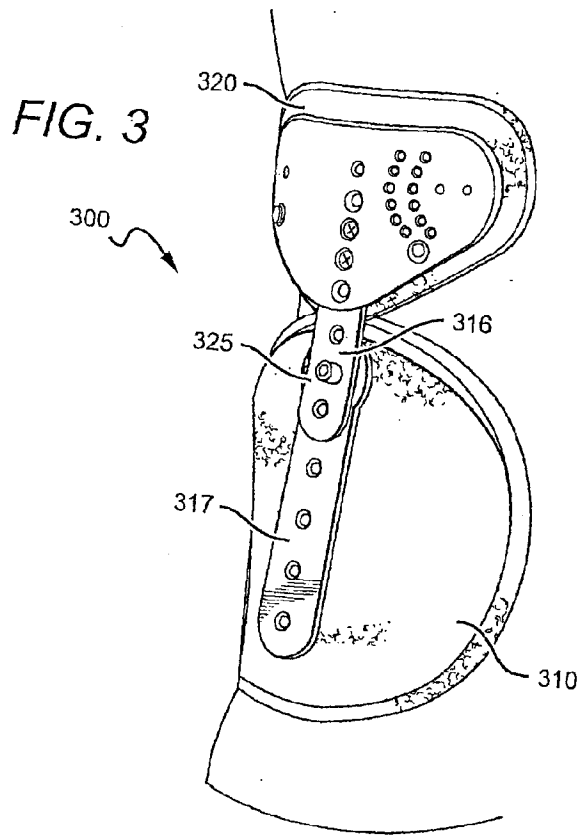


FIG. 2

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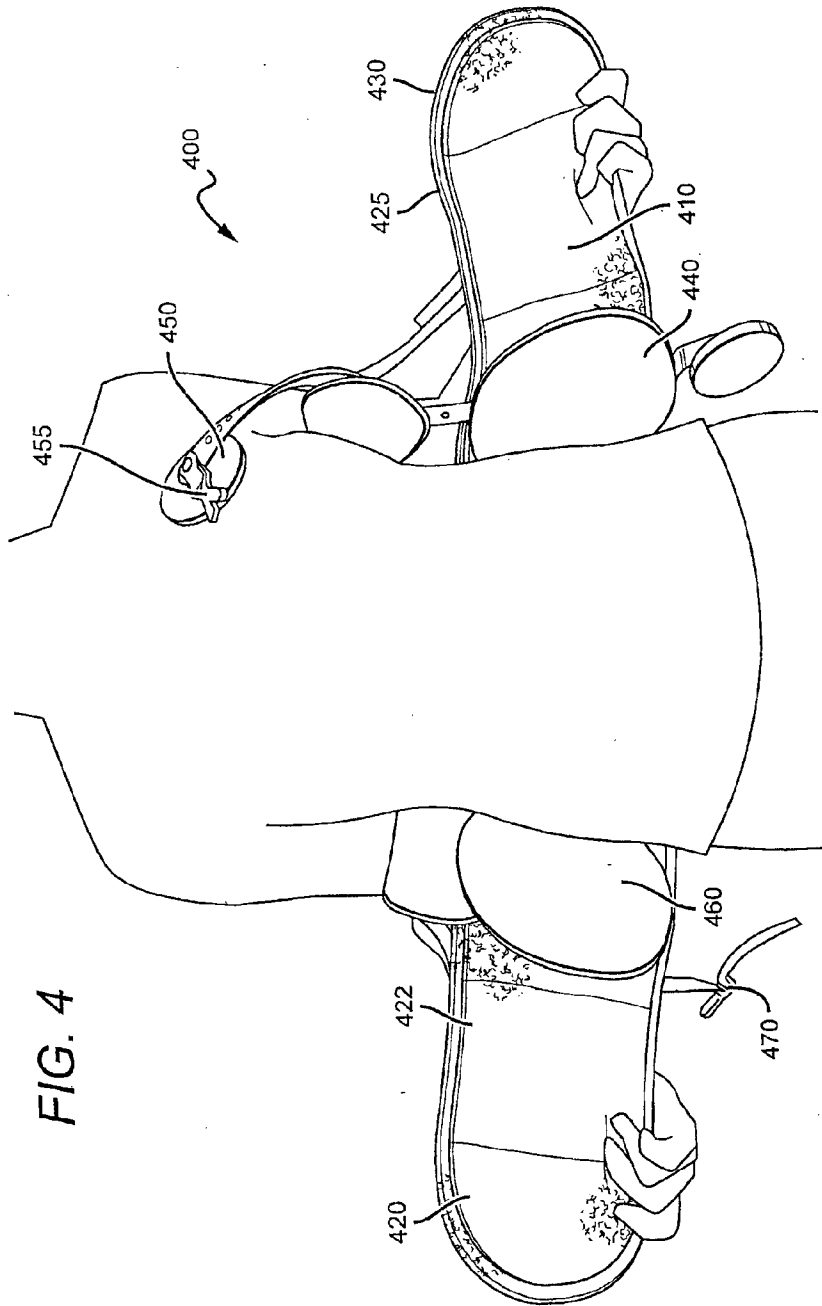


FIG. 4

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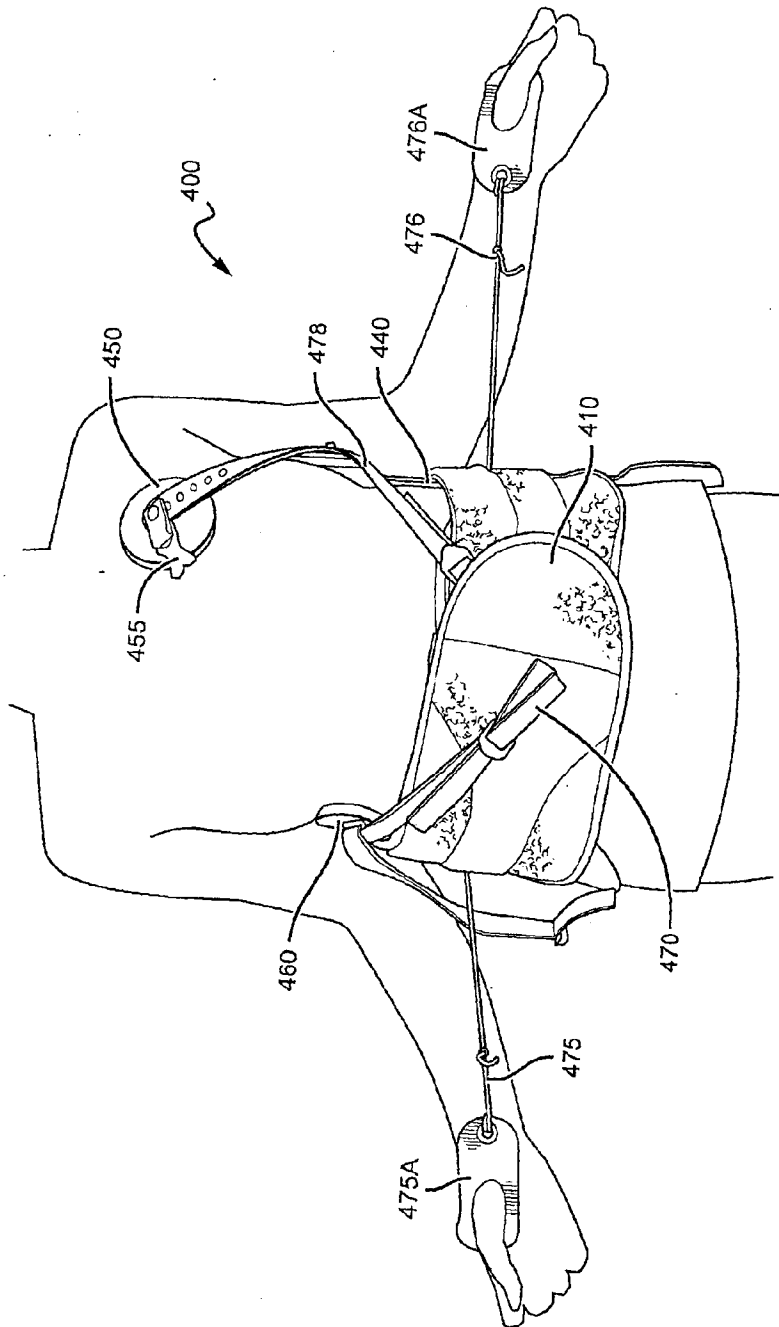


FIG. 5

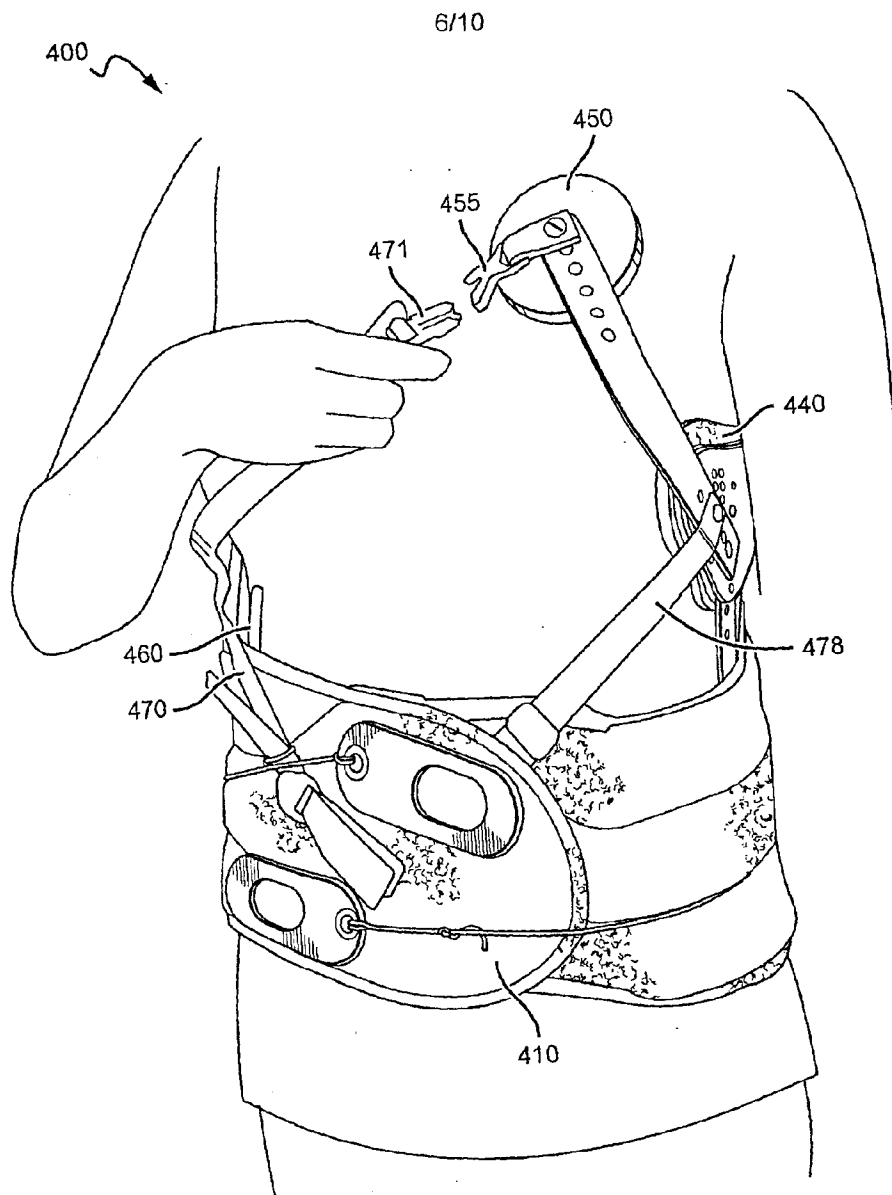


FIG. 6

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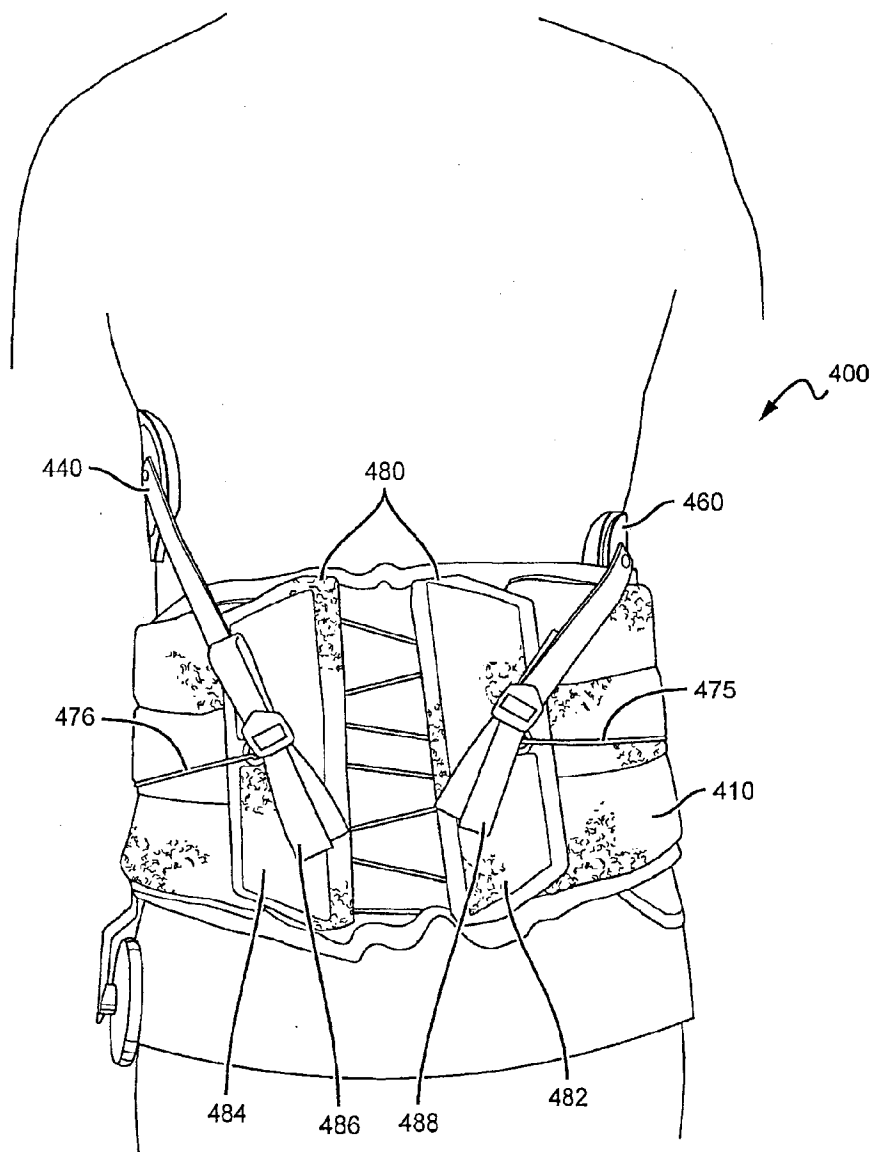
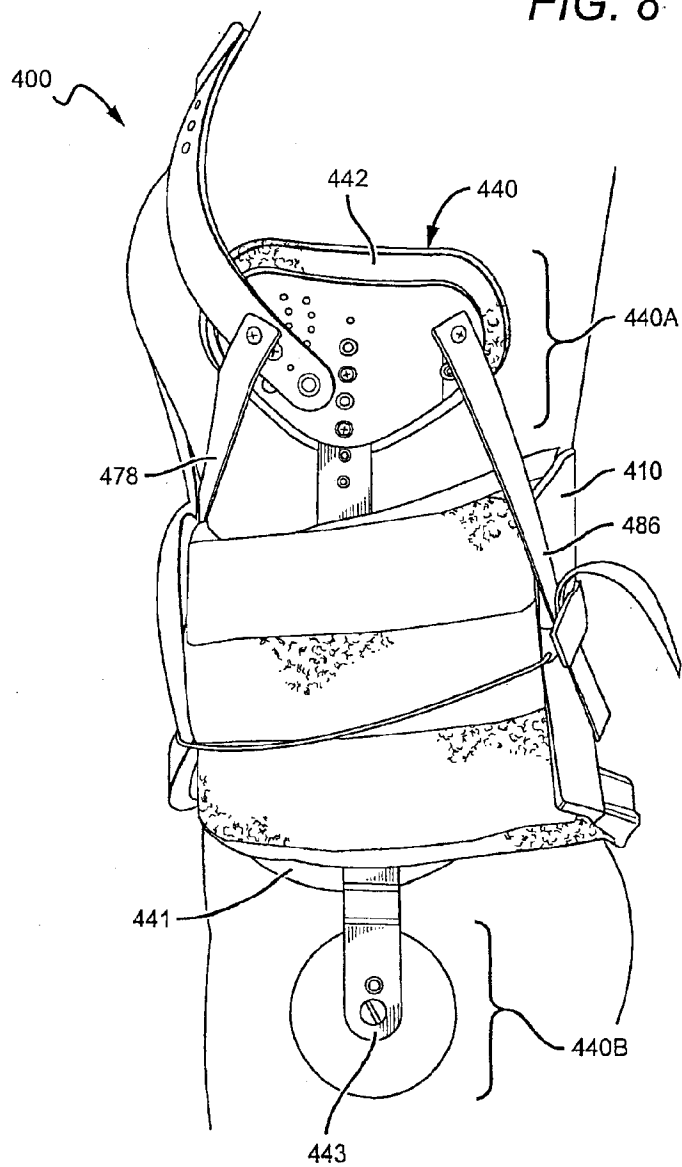
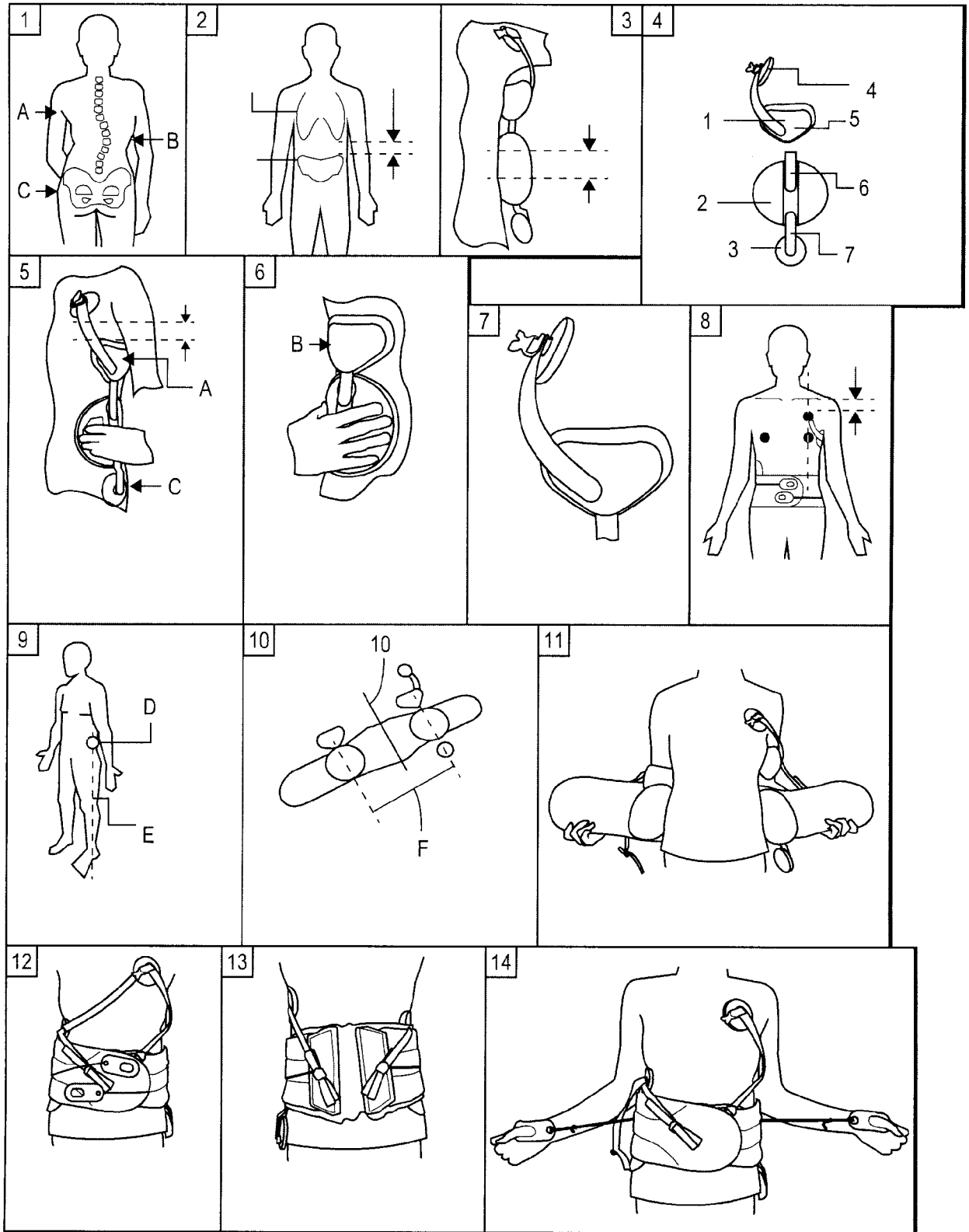


FIG. 7

FIG. 8





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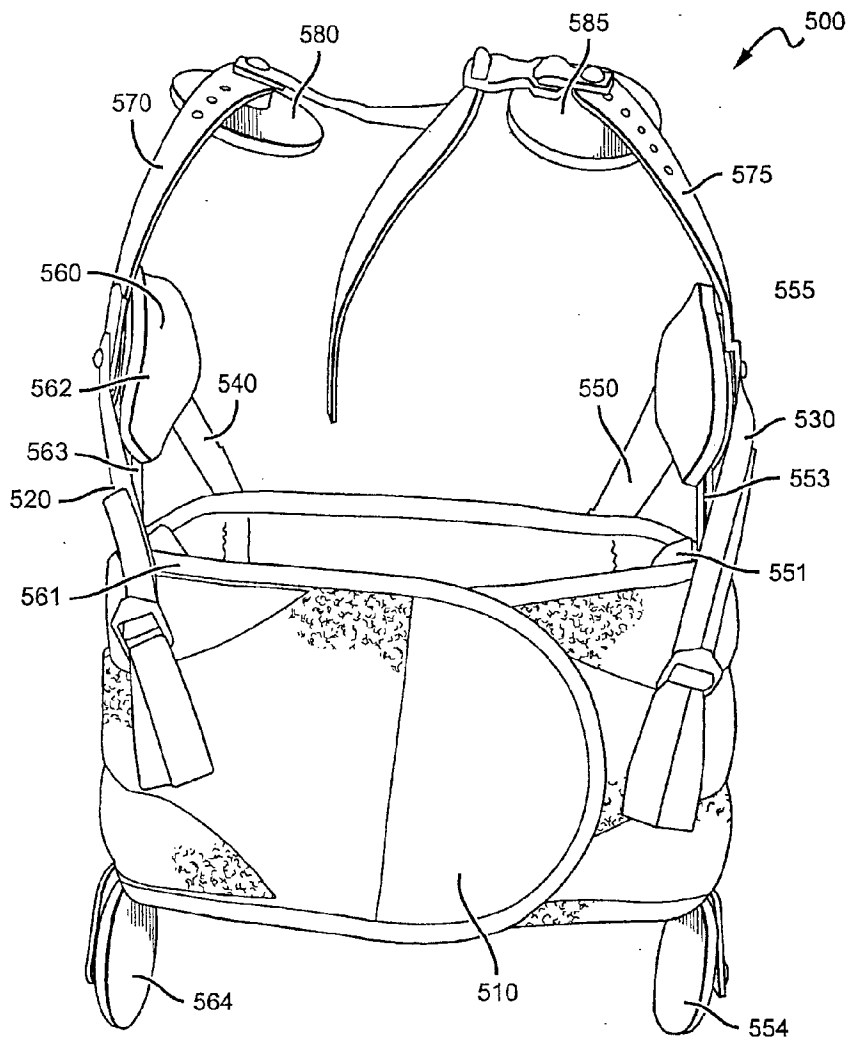


FIG. 10

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