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(54) **PORTABLE DEVICE FOR UNLOADING LOWER BACK WHILE SITTING**

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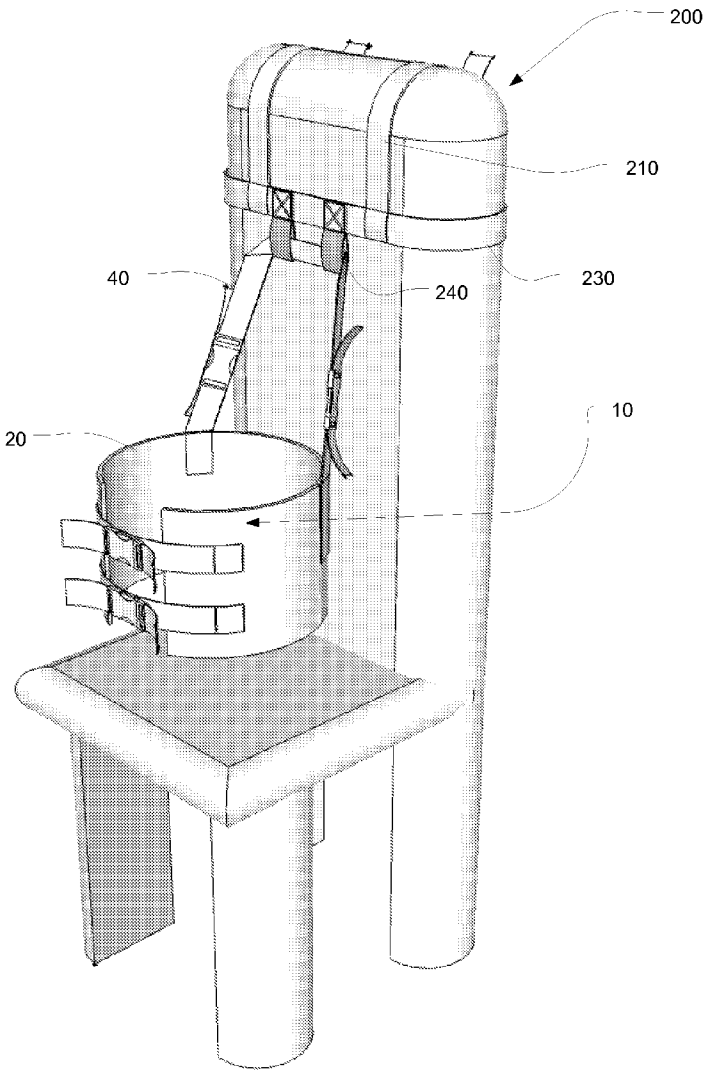
(52) **U.S. Cl.** **297/391**; 297/464

(57) **ABSTRACT**

A portable harness that wraps around the rib cage and thoracic spine is disclosed. Unlike other harnesses, the present invention has an extension allowing it to be suspended above the user's ribcage to apply an upward pull. This suspension strap provides a distracting/unloading force on the lower back by holding the upper torso in place while the weight of a patient's lower body creates traction on the lumbar spine. The harness can be used with any chair back, including office chairs, or vehicle seats. This allows people with lower back pain to sit more comfortably while sitting in a regular chair, driving a car, or flying in a plane. This will decrease low back pain since sitting for long periods will no longer compress the lumbar spine, it will actually be therapeutic by allowing a person to sit in an unloaded position.



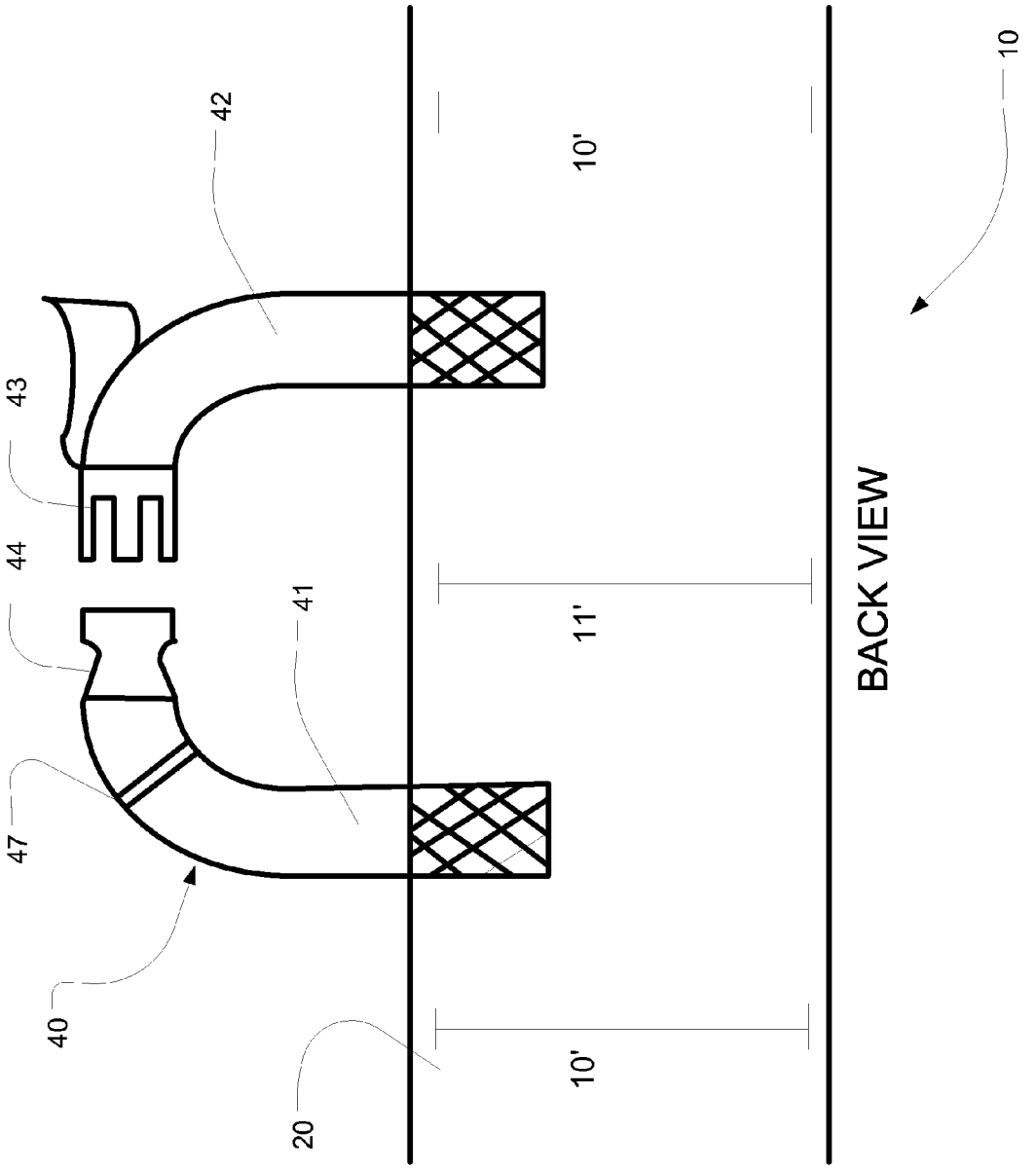


FIG. 1A

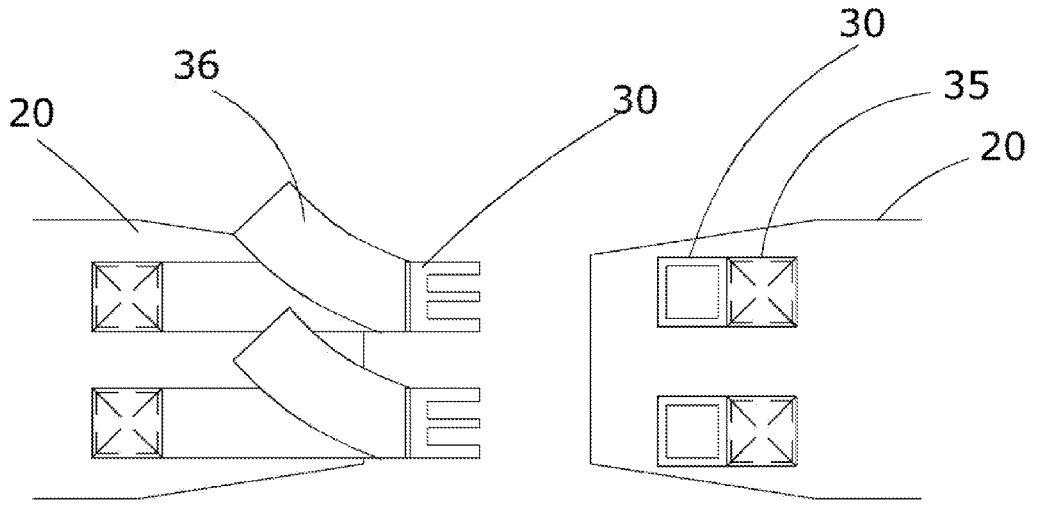


FIG. 1B: Front View

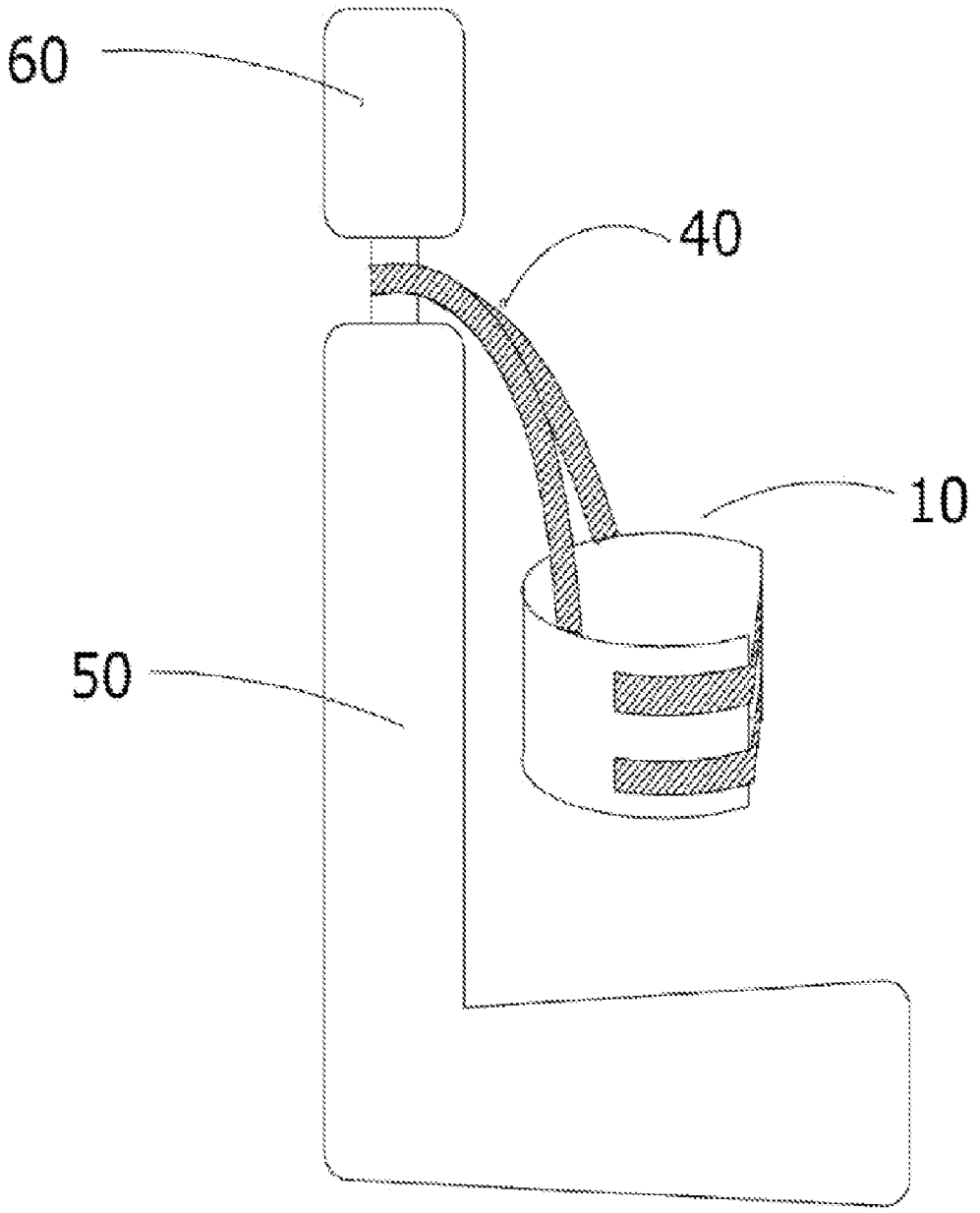


FIG. 1C

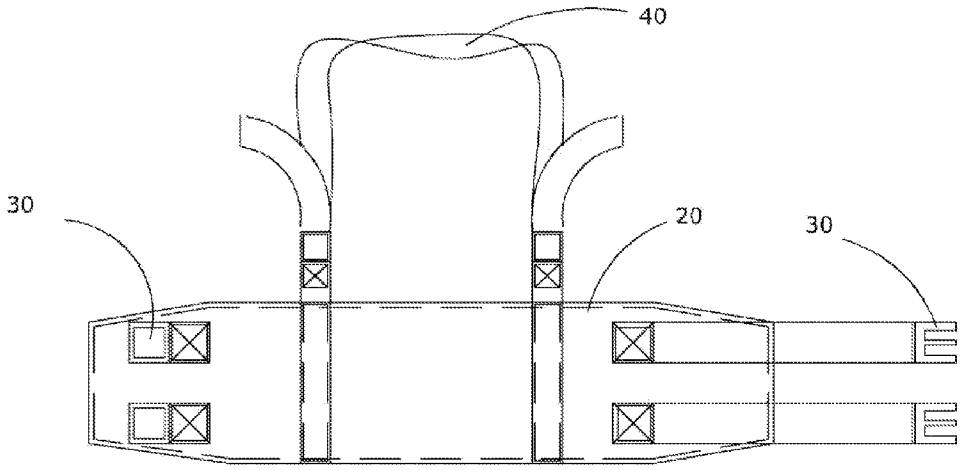


FIG. 1D: Outside

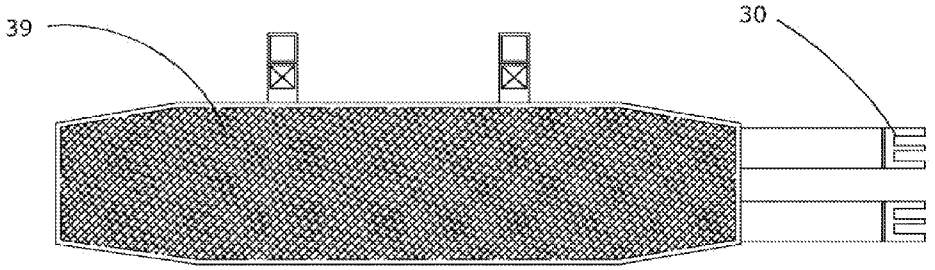


FIG. 1E: Inside

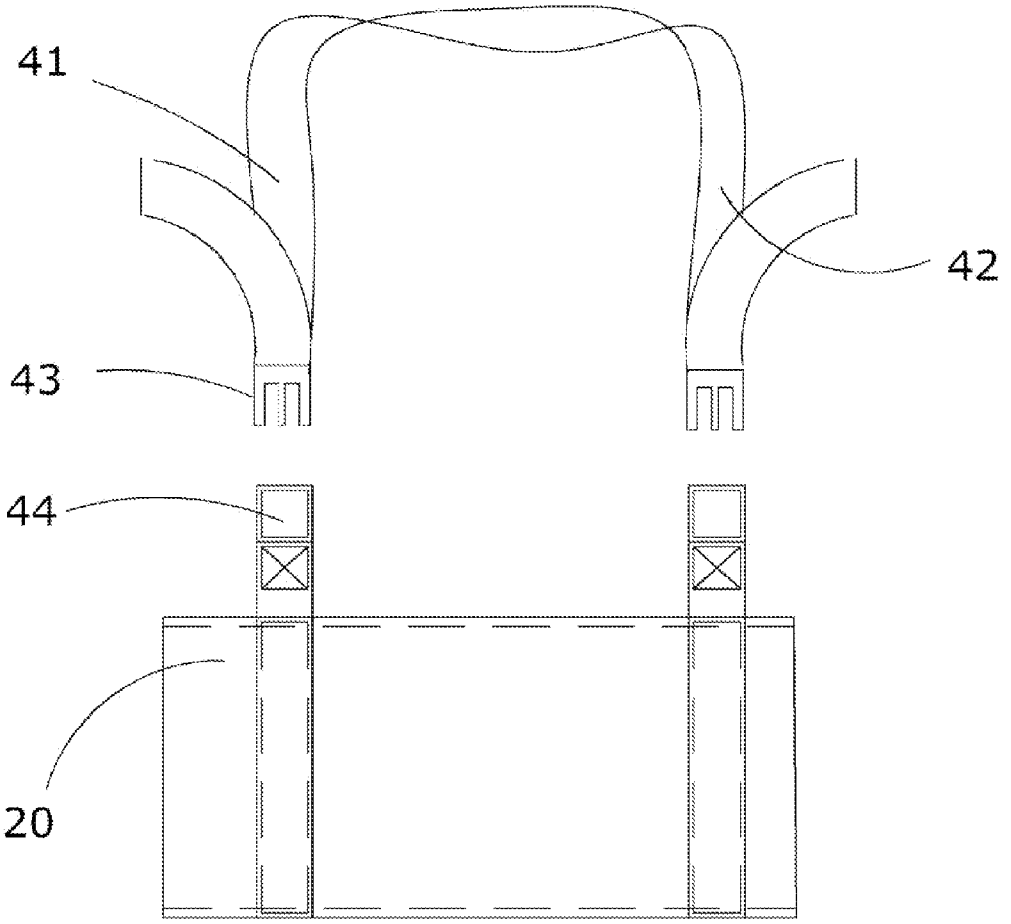


FIG. **2** : Back View

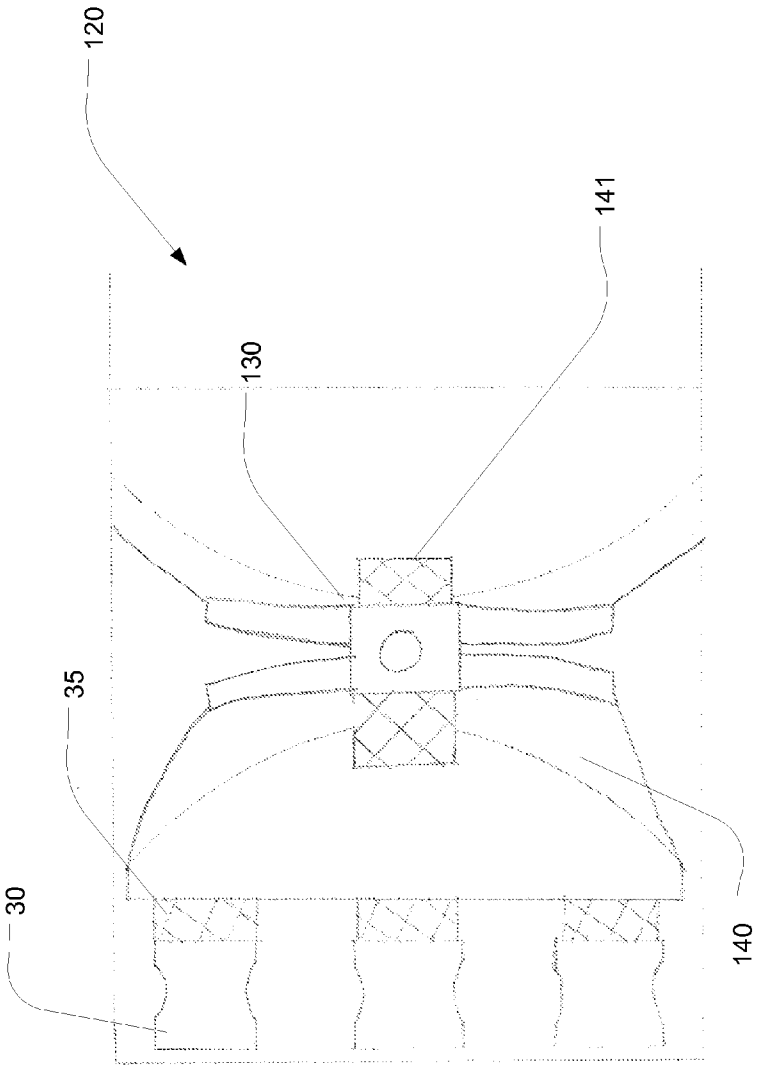


FIG. 3

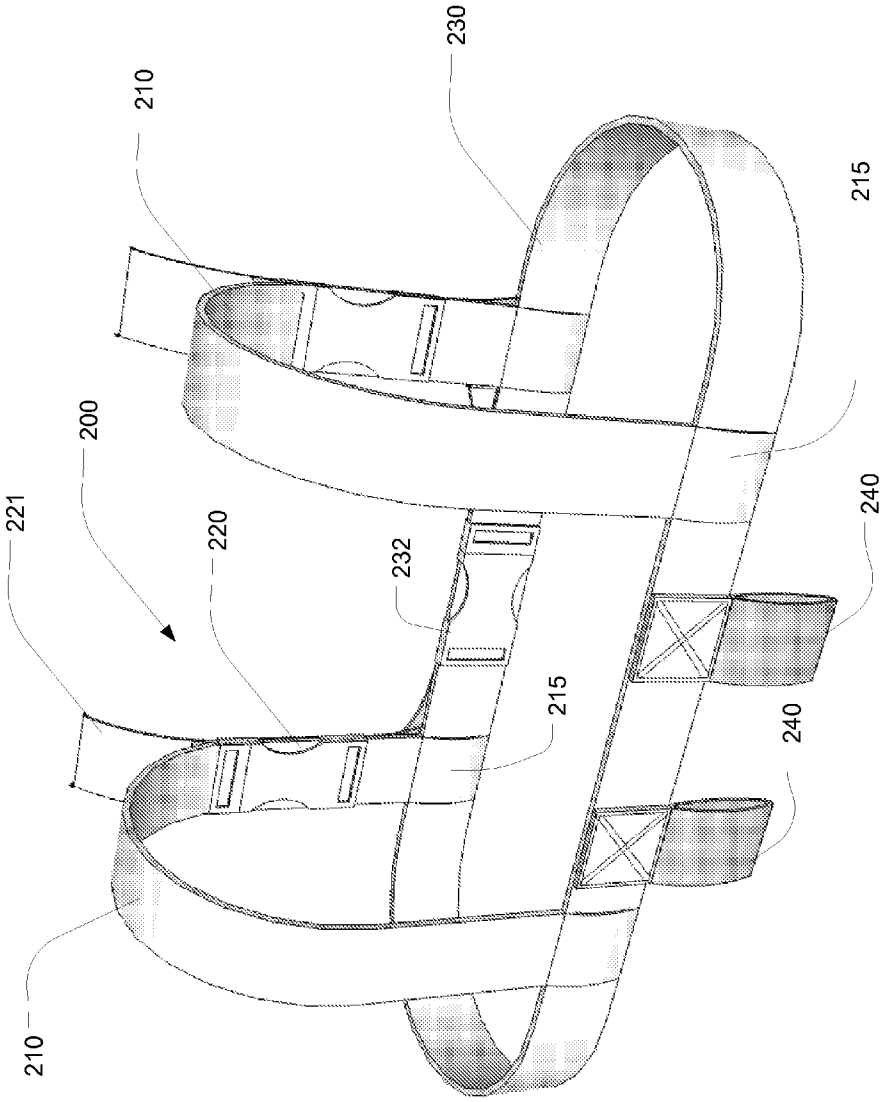


FIG. 4

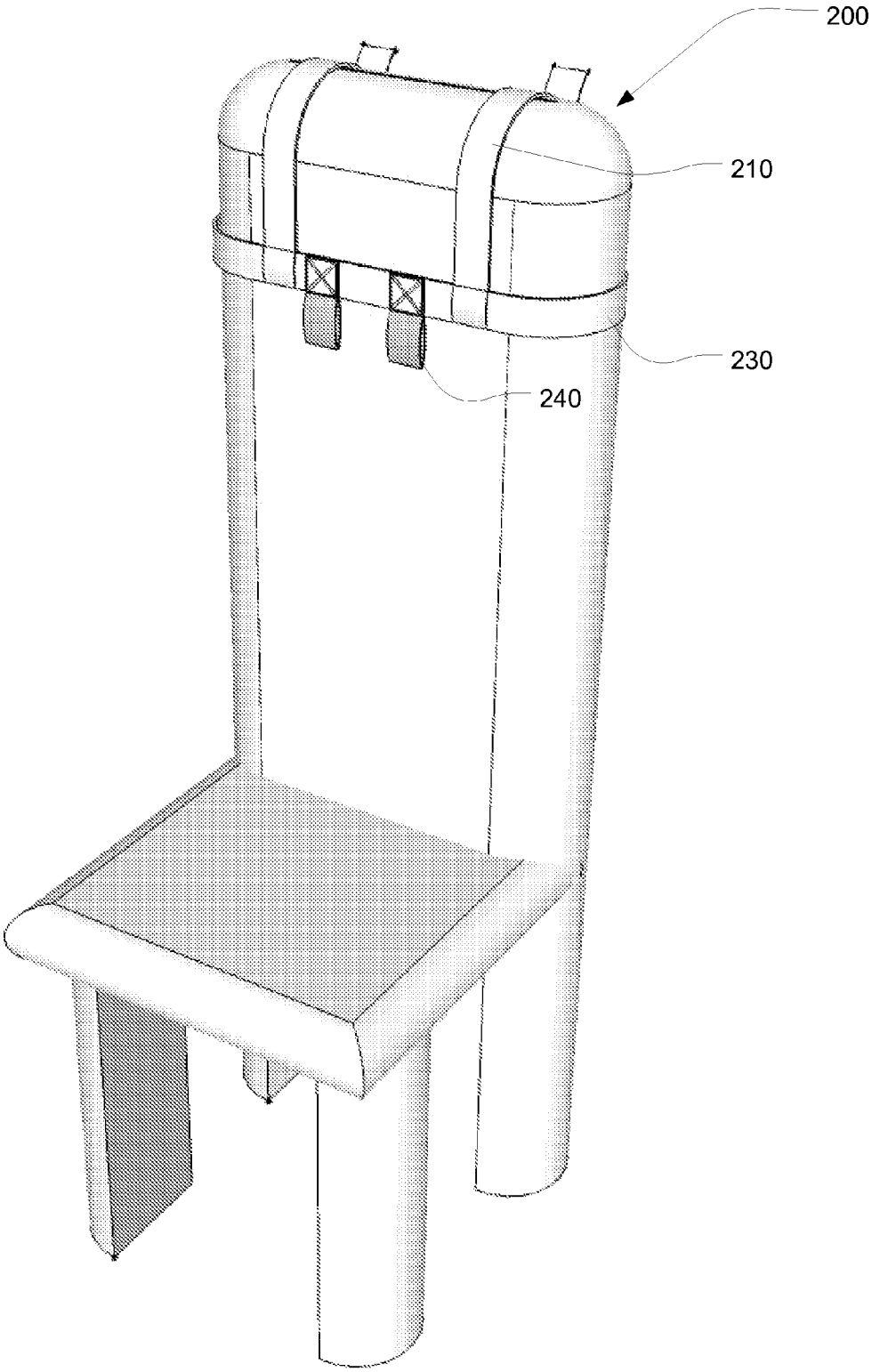


FIG. 5

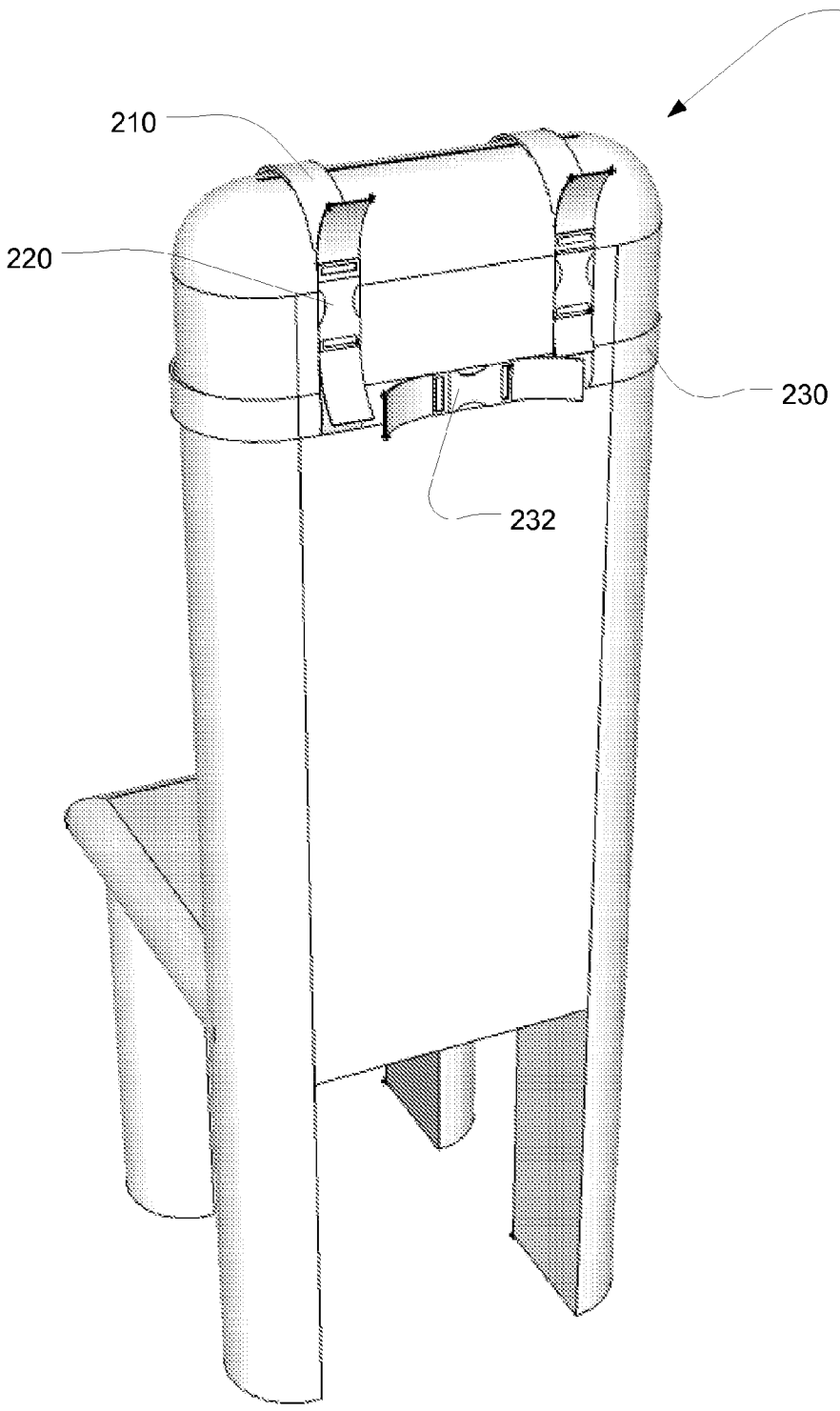


FIG. 6

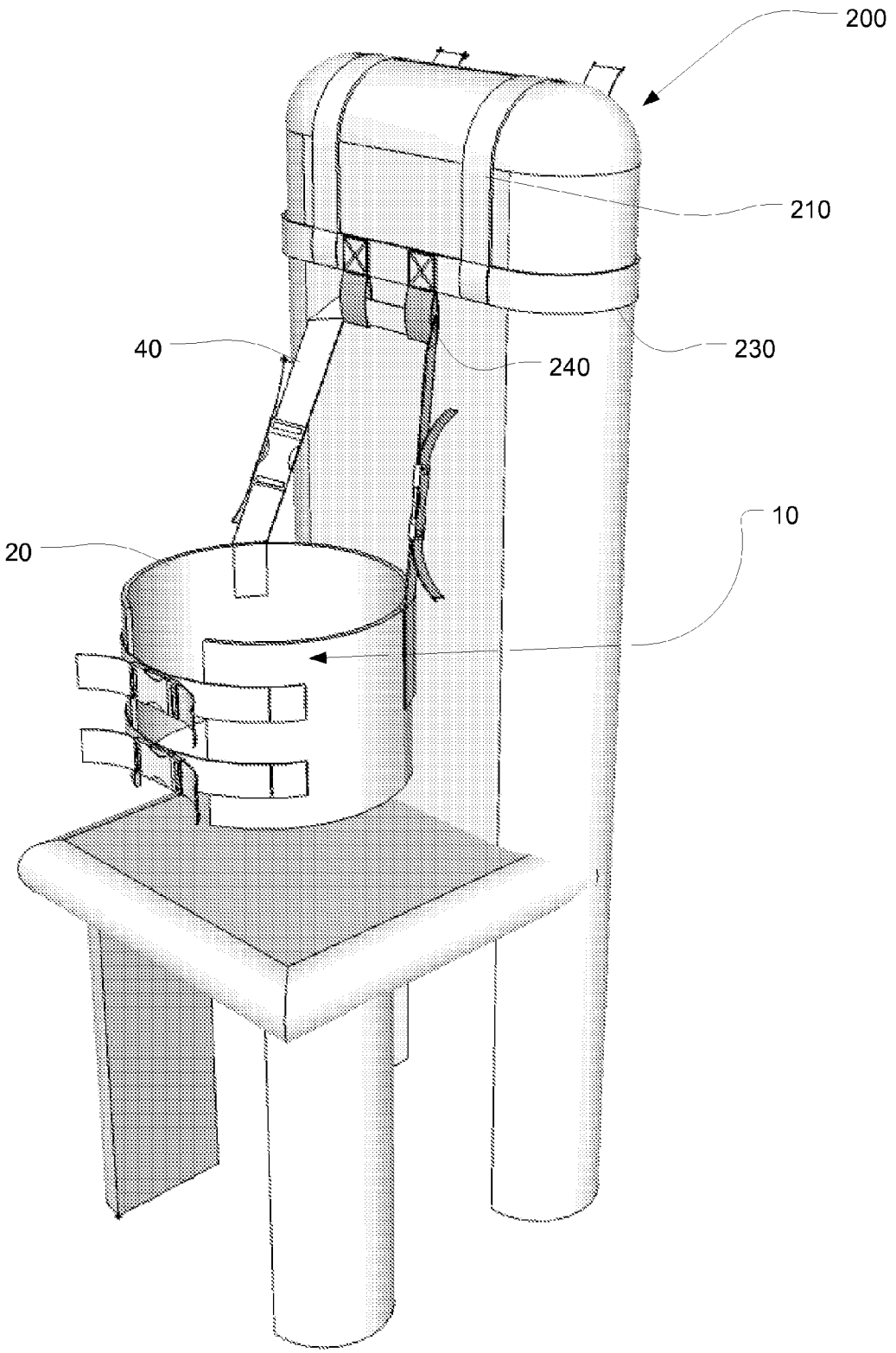


FIG. 7

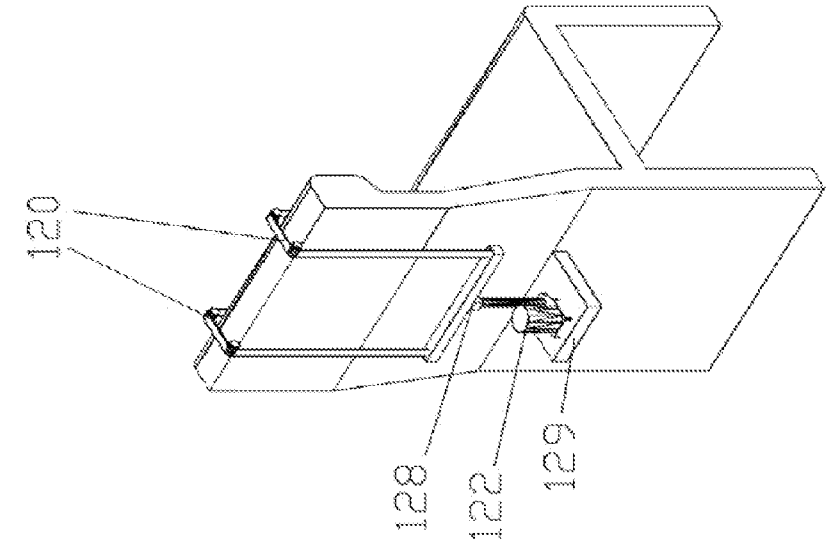


Fig 8B

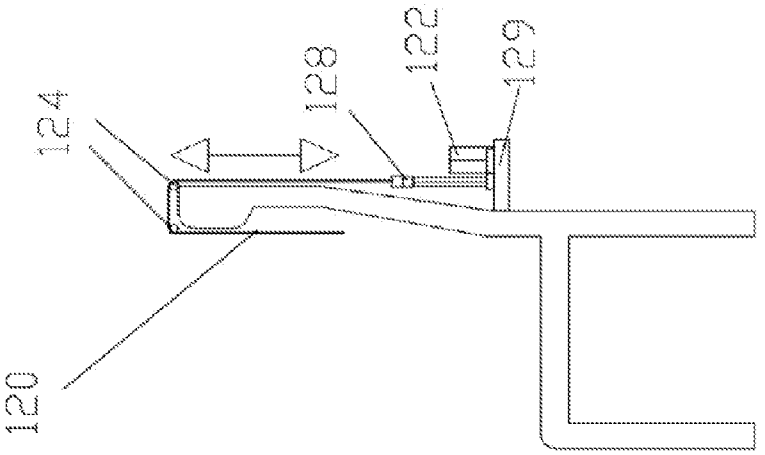


Fig 8A

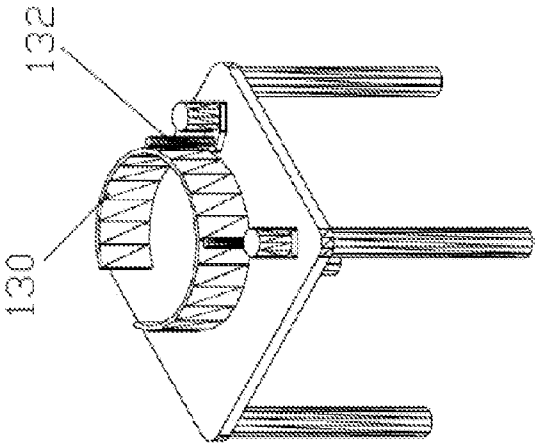


Fig 9B

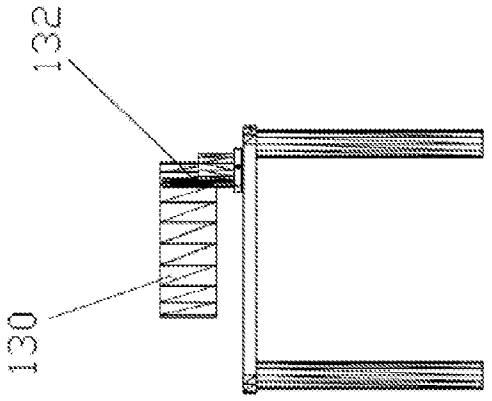


Fig 9A

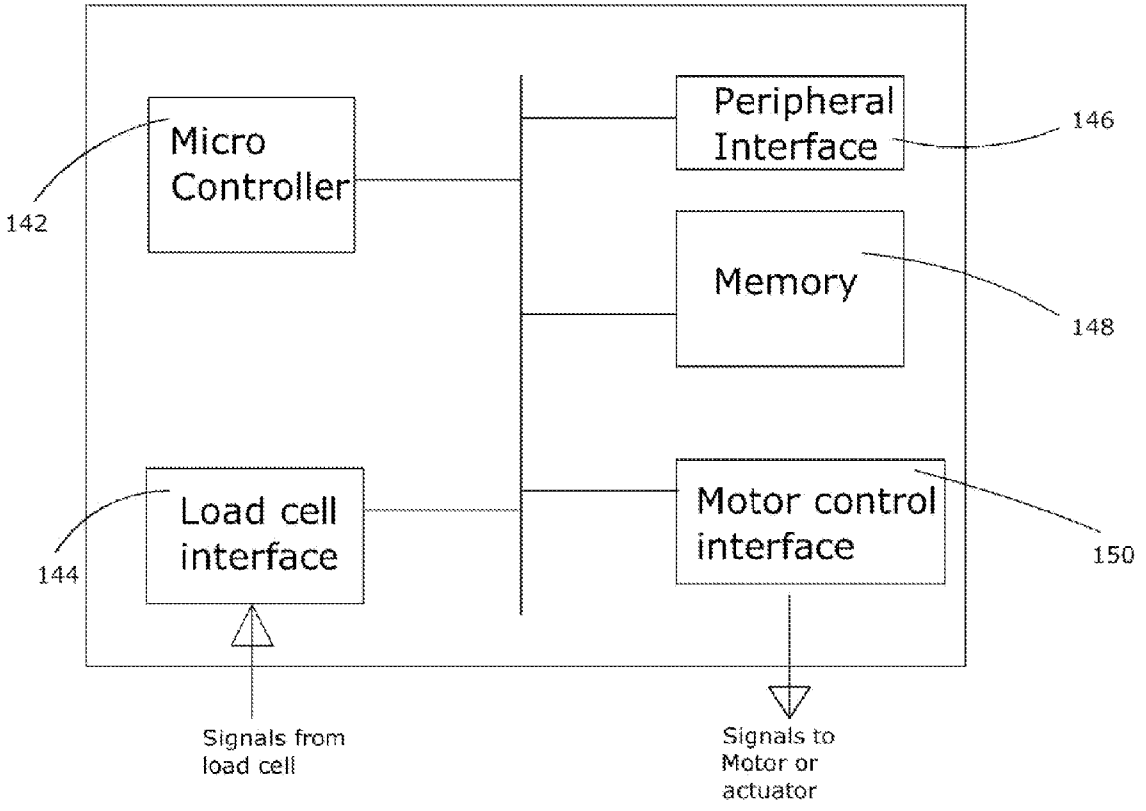

Micro Controller
142
Peripheral Interface
146
Memory
148
Load cell interface
144
Motor control interface
150
Signals from load cell
Signals to Motor or actuator

FIG. 10

PORTABLE DEVICE FOR UNLOADING LOWER BACK WHILE SITTING

[0001] This application claims priority of U.S. Provisional Patent Application Ser. No. 61/298,019, filed Jan. 25, 2010 and U.S. Provisional Patent Application Ser. No. 61/374,908, filed Aug. 18, 2010, the disclosures of which are incorporated herein by reference in their entireties.

BACKGROUND OF THE INVENTION

[0002] Lower back pain is one of the most common ailments among Americans. In fact, 8 out of 10 people will suffer from lower back pain (LBP) at some point in their life. At any point in time, over 30 million Americans suffer from lower back pain.

[0003] To cope with this pain, a myriad of treatments have been devised. Physical therapists and chiropractors have long used traction (also referred to as unloading and decompression) to help treat patients with low back pain.

[0004] One particular example uses a compound mechanical bed, where the head and foot ends move in opposite directions while the patient is secured to the moving parts. However, such beds are expensive.

[0005] Another common technique is the use of gravity boots, which allow the user to hang, typically upside down, by attaching hooks on the boots to a horizontal rod. By hanging with the feet elevated and the head lowered, the spine is stretched.

[0006] Other treatments serve to reduce the pressure on the lower back by reducing the load that the spine must support. However, most of these traction devices are meant to be used in the supine or standing position.

[0007] Unfortunately, a major complaint of many people with LBP is the pain associated with sitting for extended periods of time. Sitting is one of the most compressive positions for the lumbar discs and joints. Compression of a disc causes irritation to disc bulges and herniations.

[0008] However, there are few systems that relieve lower back pain while the person is in the seated position. Therefore, it would be beneficial if there were an apparatus and method to allow the unloading of the spine while in the sitting position.

SUMMARY OF THE INVENTION

[0009] A portable harness that wraps around the rib cage and thoracic spine is disclosed. Unlike other harnesses, the present invention has an extension allowing it to be suspended above the user's ribcage to apply an upward pull. This suspension strap provides a distracting/unloading force on the lower back by holding the upper torso in place while the weight of a patient's lower body creates traction on the lumbar spine. The harness can be used with any chair back, including office chairs, or vehicle seats. In the case of an office chair, the harness also includes a hanger, which wraps around the chair back and provides a mechanism to support the suspension strap. This allows people with lower back pain to sit more comfortably while sitting in a regular chair. In other embodiments, the suspension strap can fit over the head rest of a vehicle's seat. This allows people to sit more comfortably while driving a car, or flying in a plane. This harness will decrease low back pain since sitting for long periods will no longer compress the lumbar spine, it will actually be therapeutic by allowing a person to sit in an unloaded position.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. **1**A is an illustration of the back view of one embodiment of the harness of the present invention;

[0011] FIG. **1**B is an illustration of the front view of one embodiment of the harness of the present invention;

[0012] FIG. **1**C is an illustration of one embodiment of the harness of the present invention with a car seat;

[0013] FIG. **1**D is an outside view of the harness;

[0014] FIG. **1**E is an inside view of the harness;

[0015] FIG. **2** shows a rear view of a second embodiment of the harness of the present invention;

[0016] FIG. **3** shows a second embodiment of the fasteners of the harness of the present invention;

[0017] FIG. **4** shows the chair support device or hanger;

[0018] FIG. **5** shows a front view of the chair support device, or hanger, installed on a chair;

[0019] FIG. **6** shows a rear view of the chair support device, or hanger, installed on a chair;

[0020] FIG. **7** shows the harness installed with the chair support device, or hanger;

[0021] FIG. **8**A & FIG. **8**B show upward pull by means of a linear actuator for a chair with back support;

[0022] FIG. **9**A & FIG. **9**B show upward pull by pushing up using a linear actuator for a chair without back support; and

[0023] FIG. **10** shows a block diagram of a microcontroller based unit to generate cyclic decompression while sitting.

DETAILED DESCRIPTION OF THE INVENTION

[0024] The present invention addresses the problem of lower back pain that is so prevalent in the seated position. In fact, the intradiscal pressure is almost at its worst in this position. The only position more compressive than sitting is bending forward. By providing a way to give patients relief in this difficult sitting position allows them to sit for longer periods of time, and also perform more tasks that are done in the seated position, such as driving a motor vehicle or working in an office chair.

[0025] FIGS. **1**A-E show one embodiment of the harness used in the present invention. The harness **10** is made up of a support **20** which wraps around the user's torso above the lumbar region. FIG. **1**E shows a non-slip lining **39** is used on the user contact side or the inner side of the support **20**. The non-slip lining **39** provides necessary grip to hold the torso without slipping during gentle vertical movements caused on the user. The vertical movements may be the result of a combination of effects such as uneven road surface, turbulent winds, shock absorbers, etc. Turning to FIG. **1**D, the harness **10** has a first end and a second end. One or more clasps **30** which serve to hold the first and second ends of the support. Also attached to the support **10** is an upper suspension strap **40**, which is suspended at a point above the user's chest, such as around the head rest of a seat, or the top of a chair back.

[0026] The support **20**, as seen in FIGS. **1**D and **1**E, is about 11 inches wide, at its widest point. The support **20** is preferably constructed of polyester, although other suitable materials can also be used. The support **20** is preferably solid, and has a length of about 28-40 inches, although other dimensions are possible. For example, in some embodiments, the support **20** may be made available in a plurality of lengths based on a

person's size. In some embodiments, as seen in FIG. **1**D, the support **20** tapers from 11 inches at its widest point to about 10 inches at its ends. This taper is intended to improve the comfort of the harness and may not exist in all embodiments.

[0027] FIG. **1**B shows a front view of the support **20**, where one or more clasps **30** are used to attach the opposite ends of the support **20** together. Preferably, these clasps are attached to lateral straps **35**,**36** which are stitched to the support **20** using polyester thread, or other suitable material. In some embodiments, the lateral straps **35**,**36** are constructed from seat belt webbing and are each about 1.5 inches wide, although other widths are also possible. In one embodiment, two lateral straps **35**,**36** are used, each separated from the adjacent lateral strap **35**,**36** by about two inches. Thus, in the embodiment shown in FIG. **1**B, the clasps **30** connect the opposite ends of the support **20** in multiple locations, thereby offering maximum support for the rib cage and torso. As shown, the lateral straps **35**,**36** and clasps **30** may be connected in such a way as to be adjustable, as is common with other types of harnesses and seat belts. In one embodiment, one of a set of lateral straps, preferably the left strap **35**, is fixed in length, and may be about 1 inch in length. The other, preferably right, strap **36** is much longer, such as between 12 and 20 inches, and is adjustable. This allows the user to properly size the lateral straps **36** so that the support snugly surrounds the torso or rib cage. In some embodiments, the width of the support **20**, when clasped together varies from a circumference of 28 inches to 55 inches.

[0028] The clasps **30** are preferably constructed from high strength plastic, so as to securely hold the support **20** together. The clasps are preferably of the snap-in variety, so that they can be easily engaged and disengaged, especially in the event of an emergency. In some embodiments, a dual side release buckle is used. Preferably, the clasps **30** are no harder to unsnap and release than a seat belt clasp in a motor vehicle.

[0029] One advantage of using multiple clasps **30** is the ability to adjust to the user's body. For example, a large person may need to adjust the lower lateral strap to accommodate their stomach area, while keeping the upper lateral straps tighter. Conversely, others may need to loosen the uppermost lateral strap (or simply not clasp the uppermost lateral strap) to accommodate their chest area.

[0030] Returning to FIG. **1**A, an upper suspension strap **40**, which includes a left portion **41** and a right portion **42**, is stitched to the support **20**, using polyester thread. The upper suspension strap **40** is preferably stitched to the outer side of the support **20**, so as to minimize the user's discomfort. The suspension strap **40** is attached to the support **20** in two locations, and extends upwardly from the support **20**. The left and right portions of the suspension strap are affixed to the support **20** approximately 12 inches apart, and are centered about the midpoint of the support **20**. The left portion **41** of the upper suspension strap **40** terminates at its distal end in a receptacle **44** into which a clasp **43** is attached. In some embodiments, an adjustment mechanism **47** is included on the left portion **41**. The right portion **42** of the upper strap **40** includes the clasp **43**. As described above, preferably the clasp **43** is attached to the right portion **42** in such a way that the length of the right portion **42** can be adjusted. In some embodiments, the entire length of the left portion **41** of the upper suspension strap **40** is between 5 and 16 inches. The adjustable right portion **42** can be as long as 20 inches or more in some embodiments. By including an adjustment mechanism **47** on the left portion **41**, it is possible to configure the upper suspension strap in a variety of configurations. For example, the clasp **43** can be positioned halfway between the two distal ends, as shown in FIG. **1**A. In another embodiment, the adjustment mechanism **47** on the left portion **41** is tightened, while the strap on the right portion **42** is adjusted so that the clasp is closer to where the left portion **41** is stitched to the support **20**. In yet another embodiment, the adjustment mechanism **47** on the left portion **41** is loosened, while the strap on the right portion **42** is adjusted so that the clasp **43** is closer to where the right portion **42** is stitched to the support **20**. By being able to adjust the position of the clasp **43**, the user is able to have the clasp **43** located at a position where it is easy to reach in the event of an emergency. For example, a right-handed user may want the clasp **43** located near the junction of the left portion **41** and the support **20**. In this way, the user can reach across their body with their right hand and unclasp the device. Conversely, a left-handed user may want the clasp **43** located near the junction of the right portion **42** and the support **20**. The clasp **43** is preferably used as an emergency release buckle.

[0031] In other embodiments, an adjustment mechanism **47** is not used. In an alternate embodiment, both the clasp **43** and the receptacle **44** may be adjusted. Note that a dual adjustable buckle may be used to perform this function. In this embodiment and the previously described embodiment, dual adjustment mechanisms are provided on either side of the clasp **43** to allow the user to configure the position of the clasp **43**.

[0032] In another embodiment, as shown in FIG. **2**, the upper suspension strap **40** may have more than one clasp **43**. In this embodiment, clasps, or emergency release buckles, **43** may be conveniently located such that a left-handed or right-handed user may easily access at least one of the clasps **43**.

[0033] To improve the safety of the harness **10**, there are multiple ways in which a driver, who is using the harness **10**, can extract themselves from the vehicle in the event of an emergency. The first way would be to unclamp the clasps located in the front of the harness. In this way, the harness **10** would remain attached to the vehicle seat, while the driver is free to exit. A second way is by releasing clasps **43** on the upper suspension strap **40**. In this way, the driver may exit the vehicle with the harness **10** still attached to their body. This method may be used if the driver cannot access the front clasps **30**, such as in an accident.

[0034] The upper suspension strap **40** may be constructed of any suitable material, such as seat belt webbing. In some embodiments, the strap is 0.75 inches wide, although other widths are also possible.

[0035] FIG. **3** shows another embodiment of the harness, in which the support **120** can be opened through the actuation of a single clasp or fastener **130**. In this embodiment, the support **120** still includes the lateral straps **35** and the clasps **30**, described above. The preferred method of using the support **120** still requires the tightening and loosening of lateral straps **35** to maintain the proper amount of compression. However, in the event of an emergency, single clasp **130** allows the user to exit immediately, by requiring only a single fastener to be actuated to release the user.

[0036] Referring to FIG. **3**, note that the clasps **30** may no longer be attached to the support **120**. Rather, they may be attached to strong polyester material **140**. The strong polyester material **140** is attached to a single fastener **130**, such as one with a center release. The single fastener **130** may be attached to the support **120** via more strong polyester material **141** and stitching.

[0037] This embodiment offers yet another method for the driver to detach themselves from the device prior to exiting the vehicle in the event of an emergency.

[0038] The upper suspension strap **40** may be held in place in a number of different ways. The upper suspension strap **40** is intended to be connected to a location above the user's lower back, preferably above the user's ribcage. In some embodiments, the strap formed by the left and right portions of the upper suspension strap surround the base of the head rest **60**, as can be seen in FIG. **1**C. The harness **10** is shown away from the seat back **50** for clarity of illustration. In use, the harness **10** will be against the seat back **50**. If properly adjusted, the harness **10** will hold the user's rib cage at a height greater than would be achieved without the harness **10**. In other words, the harness **10** actually supports at least a portion of the user's weight at a position above the lower back. This decompresses the spine.

[0039] The harness **10** works in conjunction with the seatback **50** to perform this function. The upward force of the suspension straps **40** tends to lift the user. Since the suspension straps **40** are located only on the back side of the harness **10**, the straps **40** tend to pull more on the back of the user. Without the seatback, the user would tend to tip forward due to the location where the force is being applied. However, advantageously, the seatback **50** holds the user's back and torso from rotating forward, and therefore allows the two rear straps **40** to be able to gently lift the user without causing any rotation.

[0040] Since the seatback **50** is important to the function of the harness, it is preferable that the seat back be in a substantially upright position. Defining 90° as completely vertical, it is preferable that the seatback **50** be at an angle of greater than 70°.

[0041] The harness is used as follows. The user first performs an initial adjustment of the harness **10**. The driver adjusts the lengths of the left and right portions **41**,**42** of the upper suspension strap **40**. The straps should be adjusted so that the harness **10** supports the user's weight, while allowing the user's buttocks to contact the seat. The adjustment of the upper suspension strap **40** may also include adjusting the straps to position the clasp, or emergency release buckle, **43** in a convenient location. In addition, this initial adjustment may include establishing the proper lengths of the lateral straps **35**,**36** so that the harness **10** is snug around the user's rib cage. This adjustment can be performed similar to that done when fitting a life preserver or other similar device.

[0042] Once this initial adjustment has been performed, the harness **10** is ready for everyday use. The harness **10** is preferably left in the seat, with the upper suspension strap **40** wrapped around the base of the seat's headrest. With the harness **10** open (i.e. the clasps **30** disengaged), the user then sits in the seat. The user lifts his/her buttocks from the seat by pressing their feet into the floor. While lifted off the seat, the user attaches the harness **10** around rib cage (preferably allowing 3 finger widths between axilla and brace to avoid pressing on axillary compartment). The base of the harness **10** is preferably just above beltline. The user then secures and tightens all of the lateral straps **35**,**36** so that the harness **10** is snug around rib cage. Once the harness **10** is secured, the user gently lowers their buttocks back down into seat. The user will then feel an upward force created by the harness **10** holding their torso slightly suspended. This will partially unweight the buttocks and provide a gentle traction on the lumbar spine while sitting.

[0043] The harness and method described herein can be employed with any vehicle, such as but not limited to automobiles, trucks, SUVs, trains and airplanes. In addition, the figures herein show a detachable headrest, where the upper suspension strap **40** is placed at the base of that headrest. However, the harness is useable in other configurations as well. For example, some seats (such as that of a bus driver) have a headrest that is integral with the seat. However, often, the headrest is narrower than the shoulder part of the seat. This creates a small indentation (concavity) at the top of the seat. This indentation is sufficient to hold the harness in place.

[0044] FIGS. **4**-**7** show an additional component that can be advantageously used with the harness to extend its utility to other chairs. FIG. **4** shows the chair support device, or hanger, **200**. The chair support device **200** includes one or more hangar loops **210**, which are configured to rest on the top of the chair on which the chair support device **200** is placed. These hanger loops **210** are preferably adjustable. In some embodiments, such as in FIG. **4**, clasps **220** are used both to attach and to adjust the length of the hanger loops **210**. In other ways, by adjusting the excess material **221** near the clasp **220**, the chair support device **200** can be moved up or down relative to the top of the chair. For a chair with a high back, the hanger loops **210** may have a greater length than the hanger loops used with a chair having a lower back. In this embodiment, the hanger loops **210** are attached to the lateral hanger strap **230** via loops **215** at either end of each hanger loop **210**. This allows the hanger loops **210** to be moved to the more stable position based on the shape of the chair back.

[0045] While FIG. **4** shows the adjustment mechanism as part of the clasp **220**, other embodiments are possible. For example, the hanger loop **210** may have a plurality of loops through its length. Any of these loops can be used to attach the hanger loop **210** to the lateral hanger strap **230**.

[0046] The lateral hanger strap **230** is used to encircle the chair back and provide stability. The length of the lateral hanger strap **230** is adjustable, based on the girth of the chair back. In some embodiments, such as that shown in FIG. **4**, the lateral hanger strap may also include a clasp **232** so that the chair support device **200** can be fastened and unfastened from the chair back. In other embodiments, the clasp **232** is not used. An alternate adjustment mechanism may be employed in this embodiment.

[0047] Attached to the lateral hanger strap **230** are one or more support loops **240**. These support loops **240** are used to receive the upper suspension strap **40** of the harness. In other embodiments, a different mechanism may be used to receive the upper suspension strap **40**.

[0048] FIG. **5** shows a front view of the chair support device, or hanger, **200** installed on a chair. Note that the support loops **240** are in the front, so as to be accessible to the user.

[0049] FIG. **6** shows a rear view of the chair support device, or hanger, **200** installed on a chair. In this embodiment, all clasps **220**, **232** are configured to be on the back side of the chair, away from the user.

[0050] FIG. **7** shows the harness **10** installed with the chair support device, or hanger, **200**. The support loops **240** of the chair support device **200** are intended to emulate the vehicle headrest, in that the upper suspension strap **40** is attached to these support loops **240**. As was described earlier, the length of the upper suspension strap **40** can be adjusted based on the height of the chair back, and the height of the user. FIG. **1**A shows the upper suspension strap attached near the top of the

support **20**. However, in another embodiment, the upper suspension strap **40** may be attached to the support **20** at a different location. For example, if the upper suspension strap **40** is attached at the midpoint of the support **20**, the harness **10** may be used with a chair having a lower back than would otherwise be possible.

[0051] In other embodiment, the harness **10** and hanger **200** may be combined with an automated cyclic decompression system to allow this activity on stationary chairs. Thus, the cyclic decompression effect can be extended to any chair with a back support including dining chair, office chair, conference room chairs, waiting room chairs by providing a linear actuator that can be programmatically controlled by microcontroller based unit as shown in FIG. **8**A, **8**B and FIG. **10**.

[0052] In this configuration, the suspension mechanism includes a tension adjustment mechanism **129** to adjust the tension of the upper suspension strap **120** as needed. The tension adjustment mechanism **129** makes it convenient to adjust the tension after sitting. The tension adjustment mechanism **129** can be power driven mechanism by linear actuators, electric motors or pneumatic means **122**. FIG. **8**A and FIG. **8**B show a linear actuator **122** pulling the suspension straps **120** up over a set of rollers **124**. In this embodiment, the tension adjustment mechanism **129** slowly pulls in and releases the strap **128**, thereby causing suspension straps **120** to move correspondingly upward and downward.

[0053] In another embodiment, a harness support to directly controlled by an actuator. FIG. **9**A and FIG. **9**B show upward force being applied to the harness support **130** by one or more linear actuators **132**. In this configuration, a chair back support is not necessary. This configuration can be adapted to several types of chairs with or without back support. The linear actuators **132** are coupled to the harness support **130** and are able to move the harness support **130** upward and downward. This embodiment does not require the suspension straps described earlier.

[0054] In a power driven adjustment mechanism, the tension can be adjusted by a digitally controlled programmable adjustment mechanism to achieve the tension levels as needed. The force or tension levels can be periodically increased and decreased by a microprocessor program as needed to effect necessary cyclic decompression. The microcontroller can be programmed to cycle through two or more different tension or force settings. The microcontroller can also be programmed to control the rate of change to reach desired force levels as well as the duration to hold at each force setting. The microcontroller can also be programmed to adjust the height of the harness as needed. For example, it can have a starting height for a user, and change to different heights during different intervals. The height adjustment can also work in combination with force adjustments. For example, the device can be programmed to increase the current height to two more inches if the upward pull or force is less than 25 kilograms. The device can also have multiple user profiles stored in its memory so that the device can be programmed to use a selected profile for a user.

[0055] FIG. **10** shows a block diagram of a microcontroller **142** based programmable unit. Signals from one or more load cells or load sensors are received by the load cell interface **144** which are converted from analog to digital form and presented to the microcontroller. The microcontroller then converts the load signals to associated load levels as measured in units such as pounds or kilograms. Using the current load levels and the program logic stored in the memory **148**, the microcontroller generates the necessary control data to the motor control interface **150**, which then converts the control data to necessary motor control signals suitable to operate the motor or linear actuator, which in turn can increase or decrease the upward pull on the suspension straps of the support **20**. The peripheral interface **146** such as USB serial interface is used to program, configure or interface with other computer systems such as personal computers or central computing systems.

[0056] With this type of digital control, all the three types of decompression, namely static, intermittent and cyclic, can be achieved.

[0057] The terms and expressions which have been employed herein are used as terms of description and not of limitation, and there is no intention in the use of such terms and expressions of excluding any equivalents of the features shown and described (or portions thereof). It is also recognized that various modifications are possible within the scope of the claims. Other modifications, variations, and alternatives are also possible. Accordingly, the foregoing description is by way of example only and is not intended as limiting.

What is claimed is:

1. A harness for unweighting a user's spine while in a seated position, comprising:

a. a support, having a first end, and a second end, adapted to surround said user's rib cage, said support comprising a mechanism to attach said first end and said second end around said user; and

b. a suspension strap extending upwardly from two locations on said support, adapted to form a closed loop.

2. A system for unweighting a user's spine while in a seated position, comprising:

a. A support, having a first end, and a second end, adapted to surround said user's rib cage, said support comprising a mechanism to attach said first end and said second end around said user;

b. A suspension strap extending upwardly from two locations on said support, adapted to form a closed loop; and

c. A seatback, having a region of concavity over which said loop is positioned, wherein said user's back rests against said seatback in an unweighted position.

3. The system of claim **2**, wherein said region of concavity comprises a detachable headrest.

4. The system of claim **2**, wherein said region of concavity comprises an integrated headrest.

5. A method for unweighting a user's spine while in a seated position, comprising:

a. Providing a seat for said user, said seat having a seatback;

b. Surrounding said user's rib cage with a harness; and

c. Suspending said harness from a position on said seatback above said user's rib cage.

6. The method of claim **5**, wherein said position comprises the head rest of said seat.

7. The method of claim **5**, wherein said seat comprises a seat back, further comprising installing a chair support device on said seat back, wherein said chair support device comprises one or more loops configured to rest on top of said seat back, a lateral strap configured to encircle said seat back, and a mechanism to receive said harness.

8. A system for unweighting a user's spine while in a seated position, comprising:

a. a support, having a first end, and a second end, adapted to surround said user's rib cage, said support comprising a mechanism to attach said first end and said second end around said user;

b. a suspension strap extending upwardly from two locations on said support, adapted to form a closed loop; and

c. a chair support device, having one or more loops configured to rest on top of a chair back, a lateral strap configured to encircle said chair back, and a mechanism to receive said suspension strap, thereby allowing said user's back to be in an unweighted position.

9. The system of claim **8**, wherein said mechanism comprises loops through which said suspension strap passes.

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