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(19) **United States**(12) **Patent Application Publication****Nakatsu et al.**(10) **Pub. No.: US 2011/0006570 A1**(43) **Pub. Date: Jan. 13, 2011**(54) **BACK SUPPORT SYSTEM AND METHOD
FOR IMPROVING THE SAME****Related U.S. Application Data**

(60) Provisional application No. 60/954,906, filed on Aug. 9, 2007.

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(US); **Makiko Maki**, Tokyo (JP)**Publication Classification**(51) **Int. Cl.***A47C 7/46* (2006.01)*A47C 7/42* (2006.01)*A45F 3/04* (2006.01)(52) **U.S. Cl.** **297/230.1**; 297/452.29; 224/627(57) **ABSTRACT**

There is provided a chair with an improved back support system and method for adjusting and arranging the same. The back support device having a rigid member with a continuously curved projection part along three dimensional curve direction to enable correction of a user's posture or spinal orientation via a plurality of fixed or positionable undulating curved supports, or a monolithic rigid support body. The proposed system and method improves user fatigue, relieves pressures to internal organs, and minimizes unintended body movement causing undesirable muscle tensions.

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LACKENBACH SIEGEL, LLP**LACKENBACH SIEGEL BUILDING, 1 CHASE
ROAD****SCARSDALE, NY 10583 (US)**(21) Appl. No.: **12/672,821**(22) PCT Filed: **Aug. 11, 2008**(86) PCT No.: **PCT/US2008/072838**

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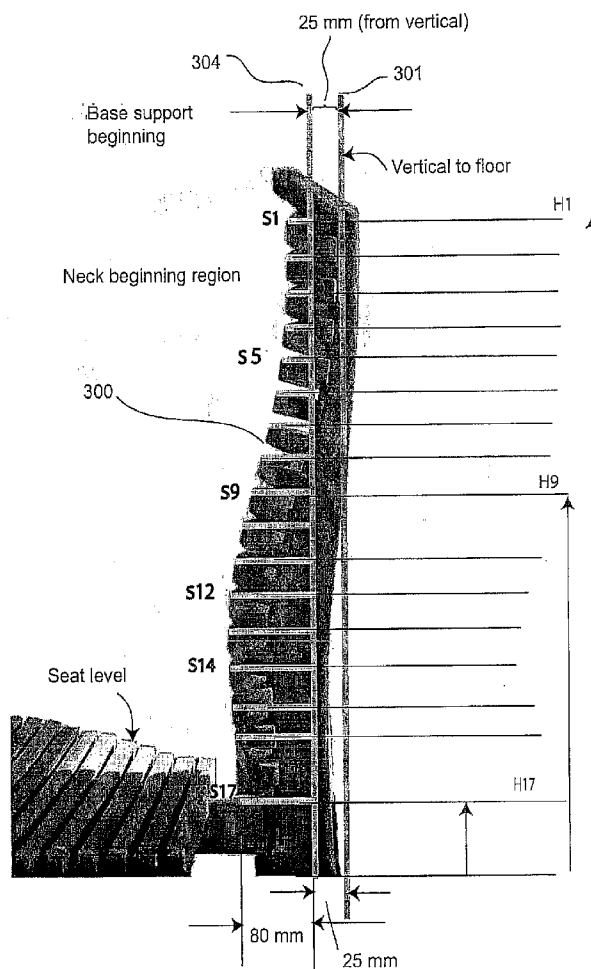
(2), (4) Date: **Sep. 29, 2010**

Fig. 1

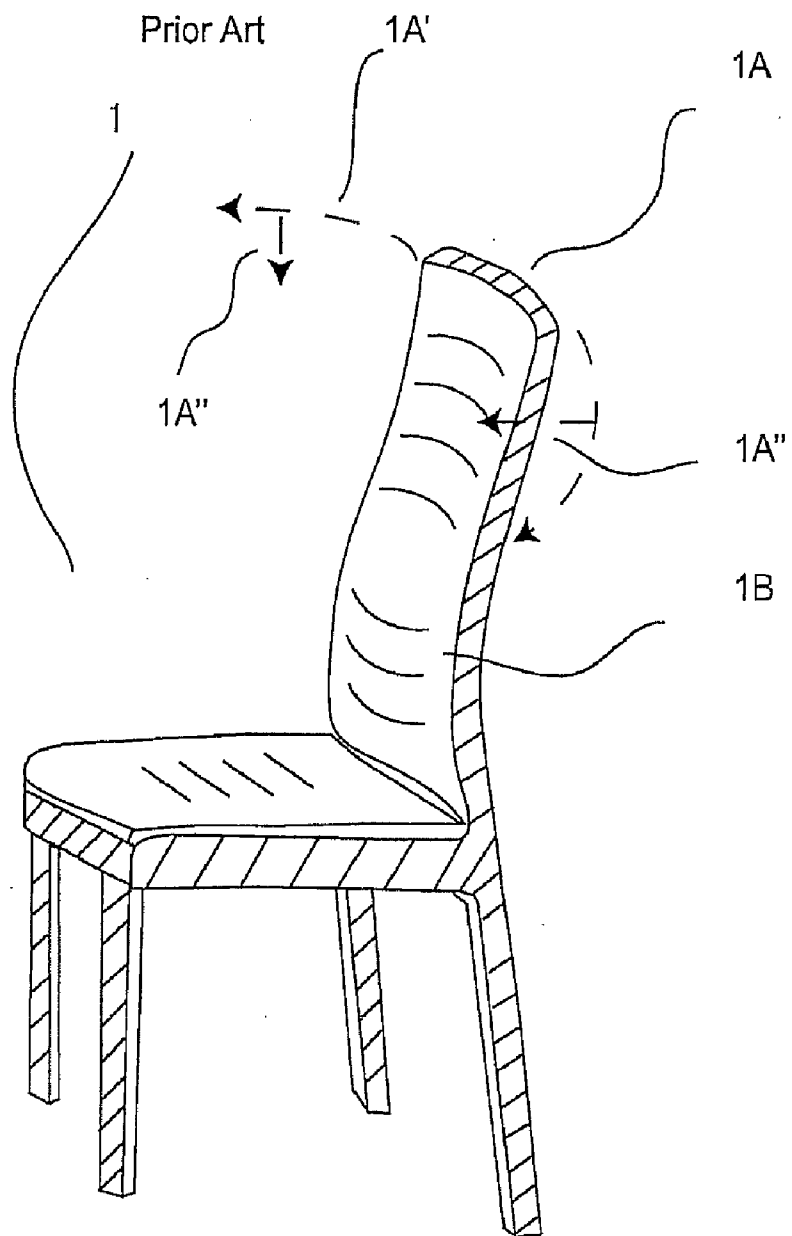


Fig. 2

Prior Art

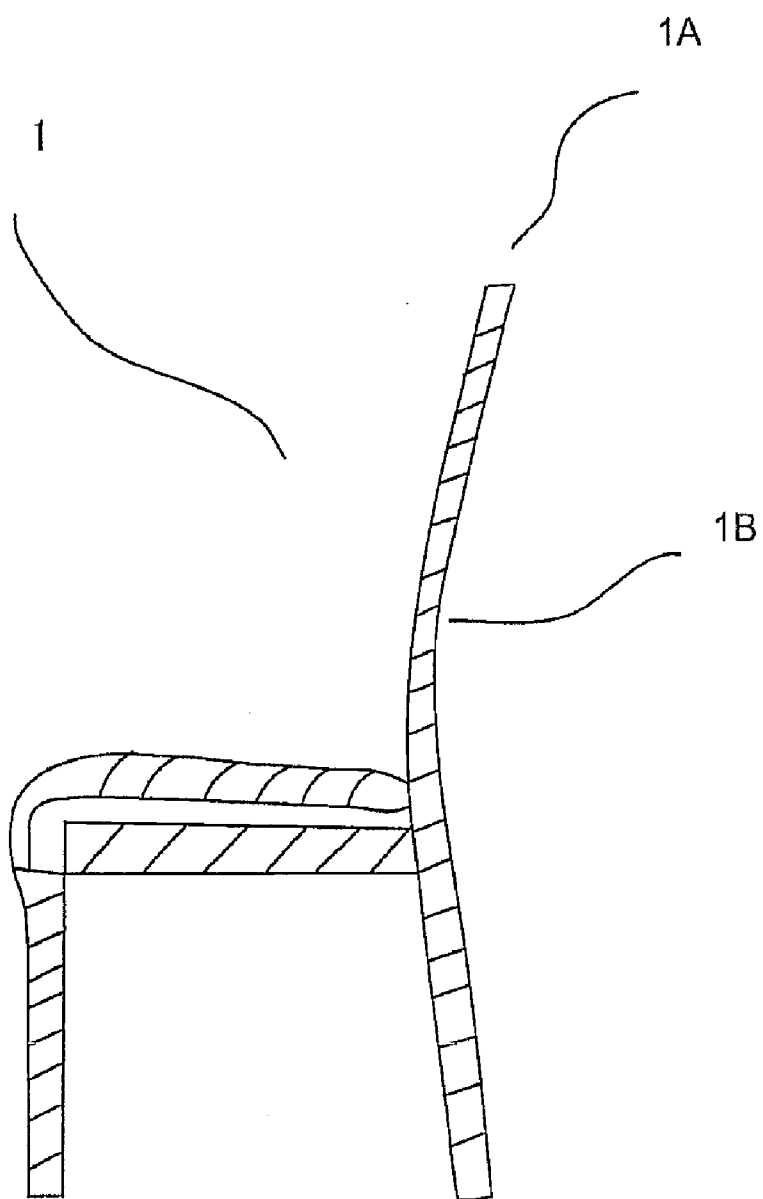


Fig. 3

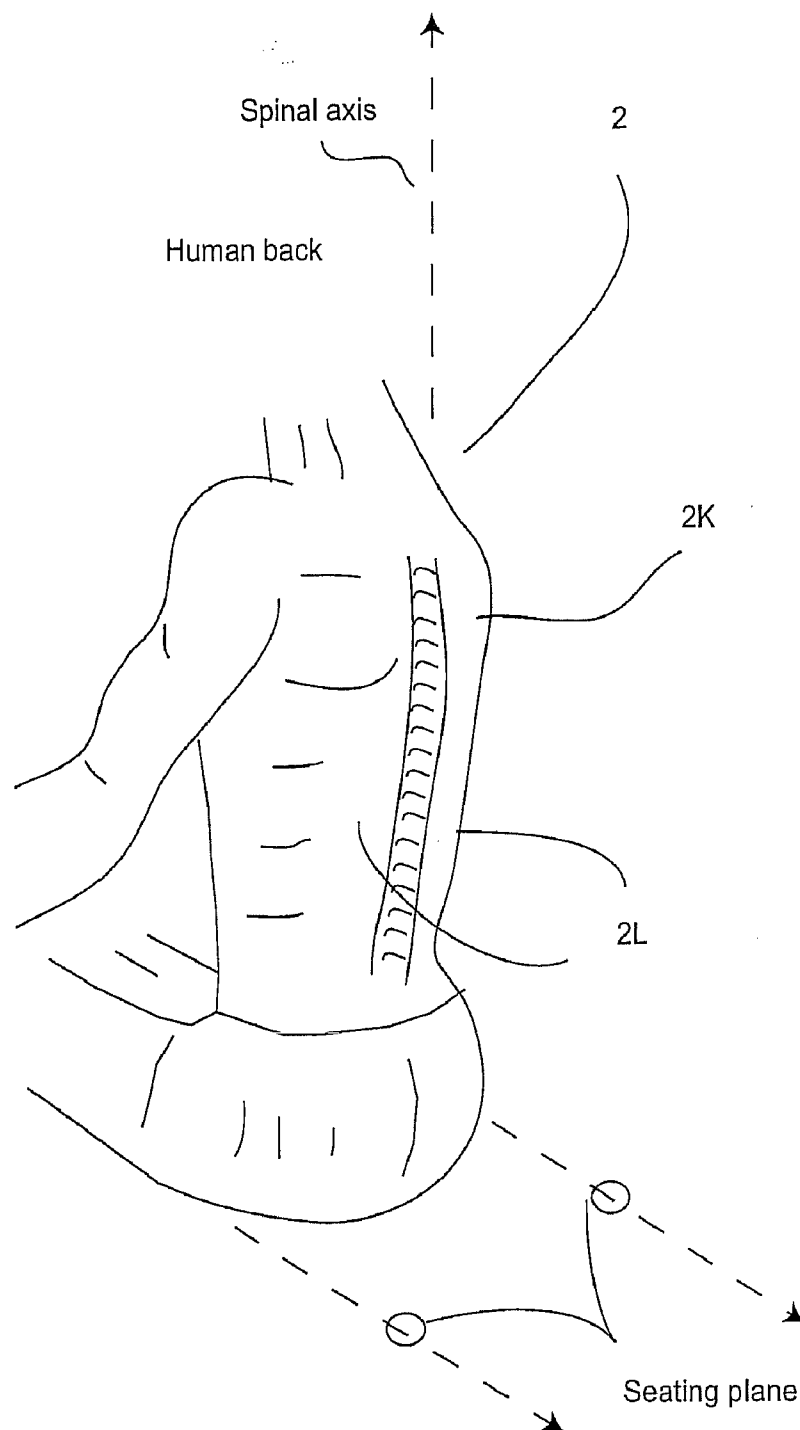
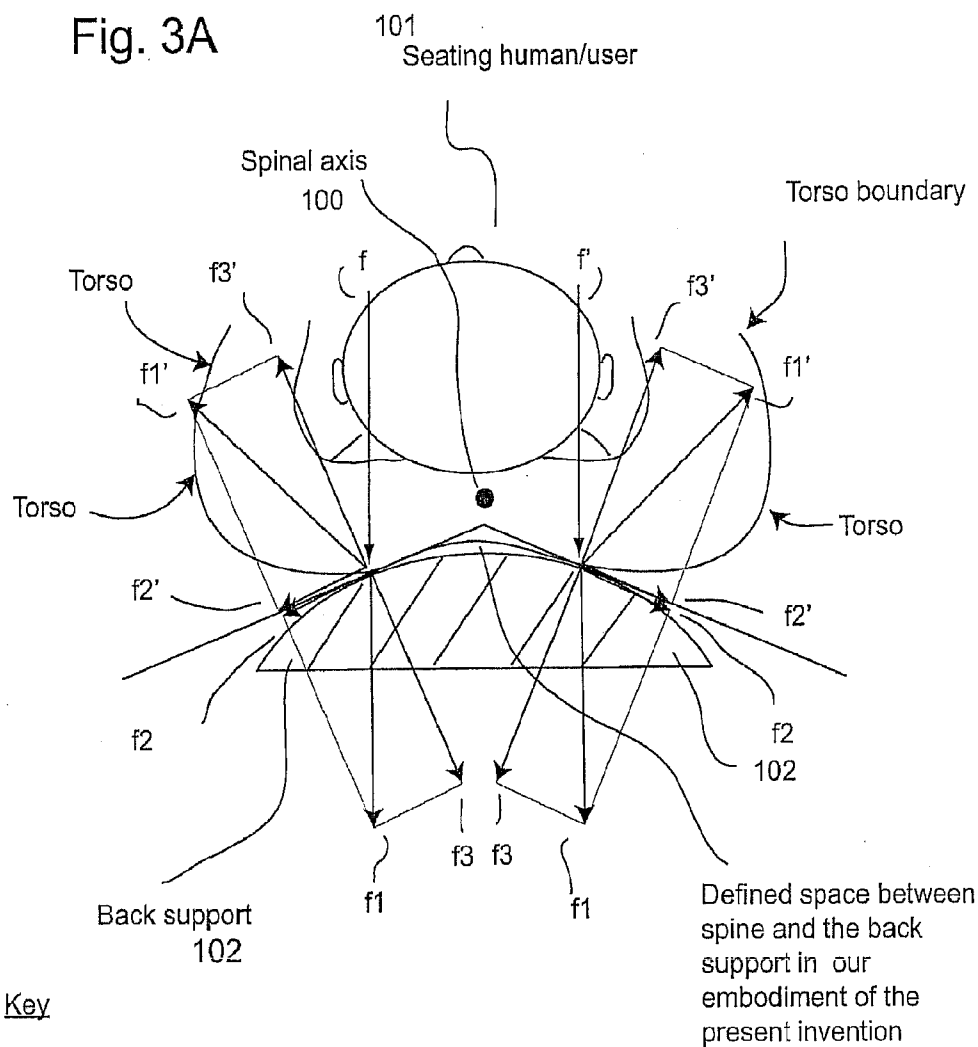


Fig. 3A



Key

f = direction of body weight

$f1$ = body weight

$f2$ = tangent vector of body weight

$f3$ = body weight directed into the body

$f1'$ = equal to the body weight

$f2'$ = tangent vector of the body weight (actual repulsion)

$f3'$ = repulsion of the body weight outward

Note:

Due to $f3'$, the body or chest will be opened outward.

In addition, there is less pressure from the back support.

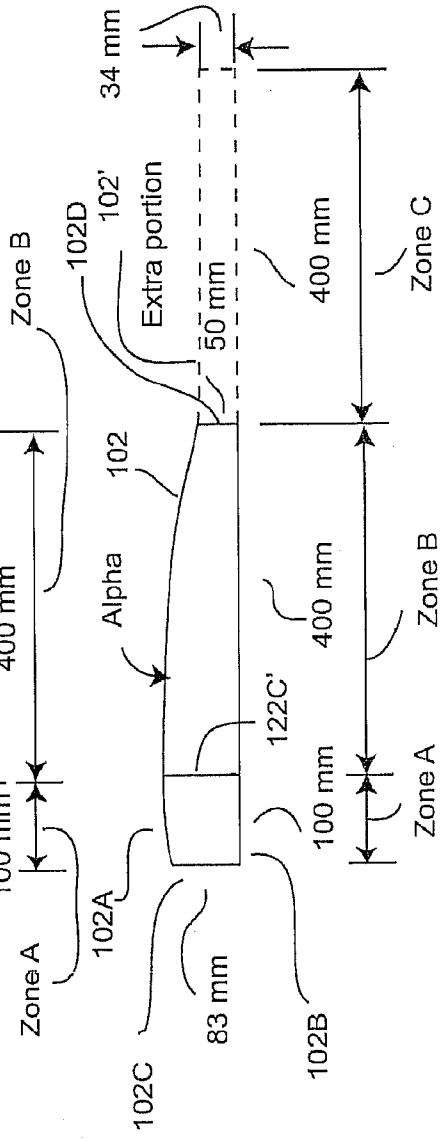
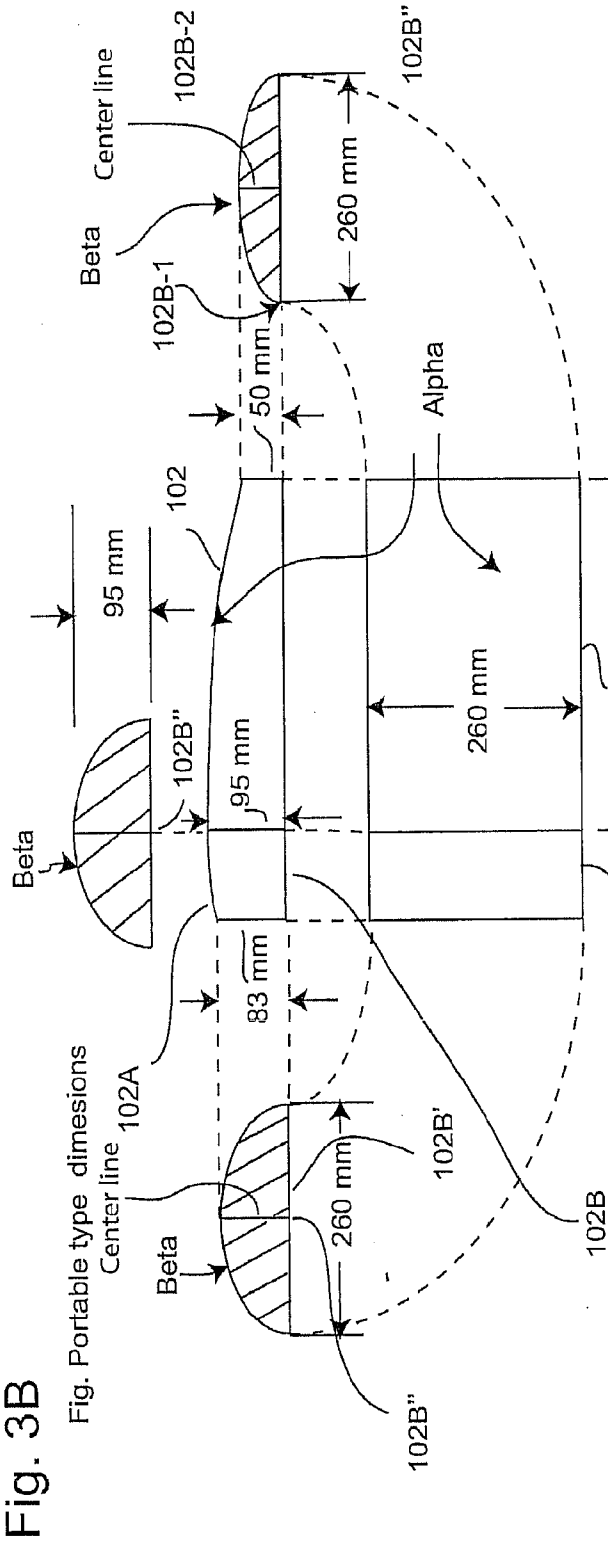


Fig. 3C

Fig. 3D

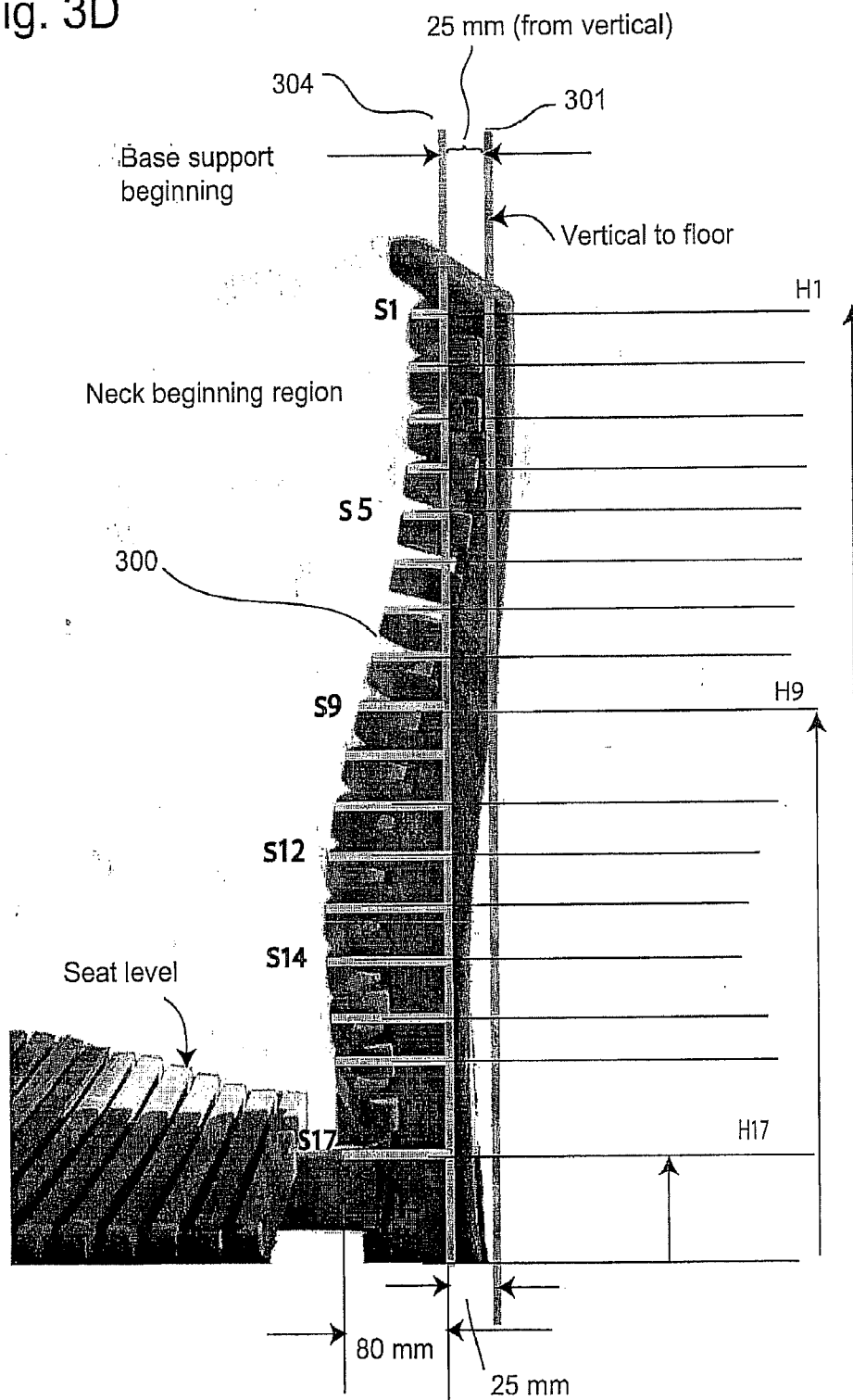


Fig. 3E

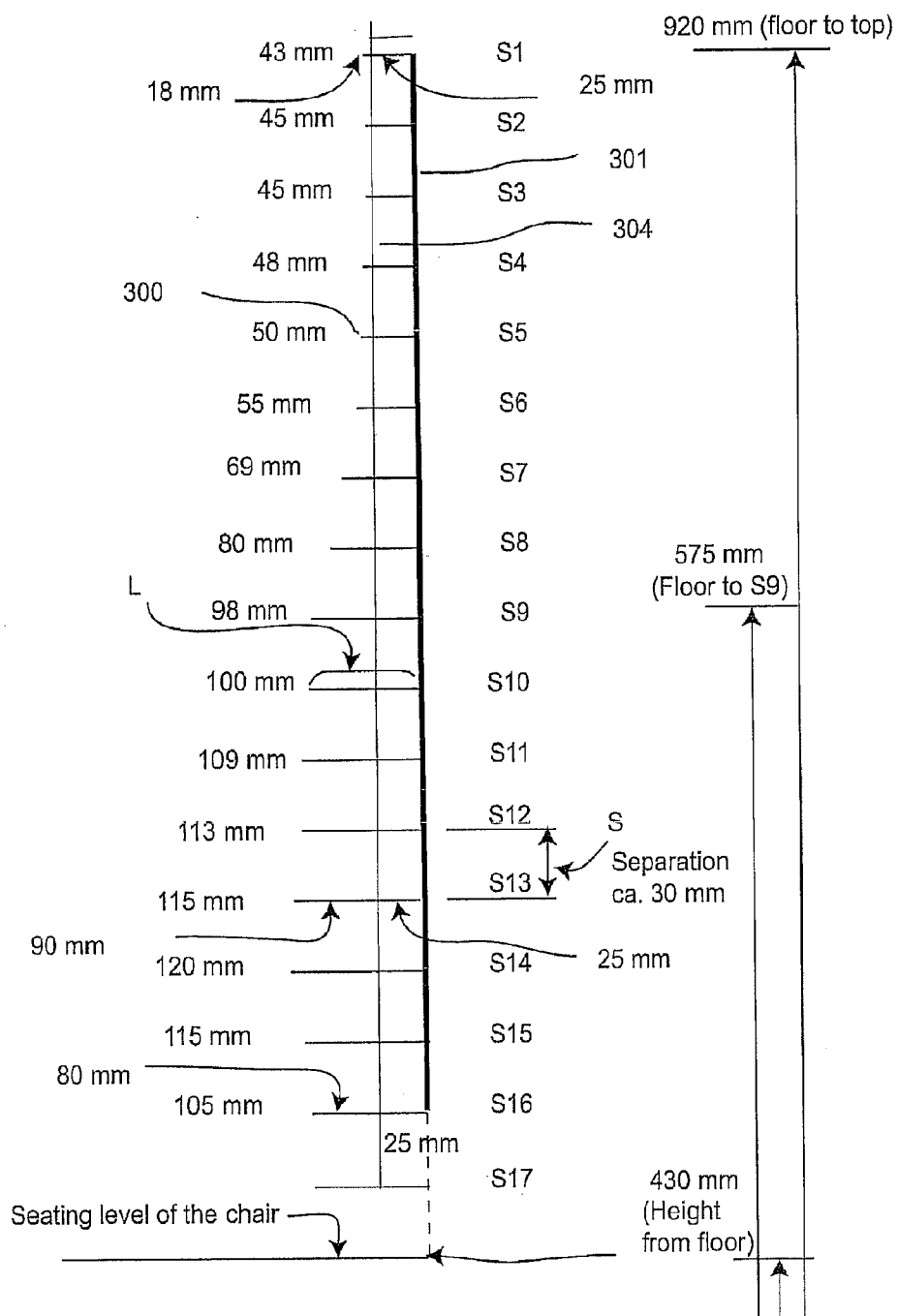


Fig. 4

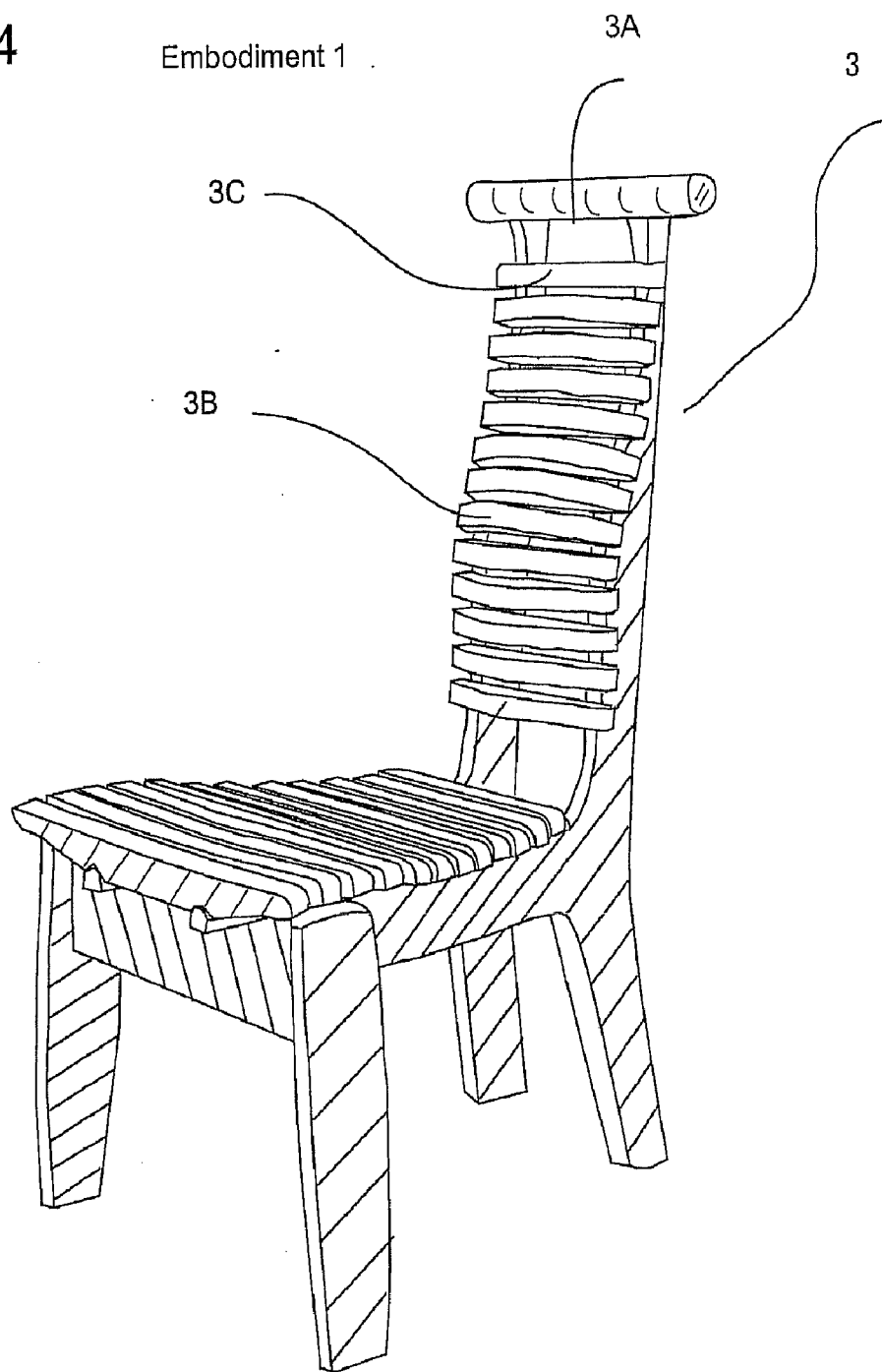


Fig. 5

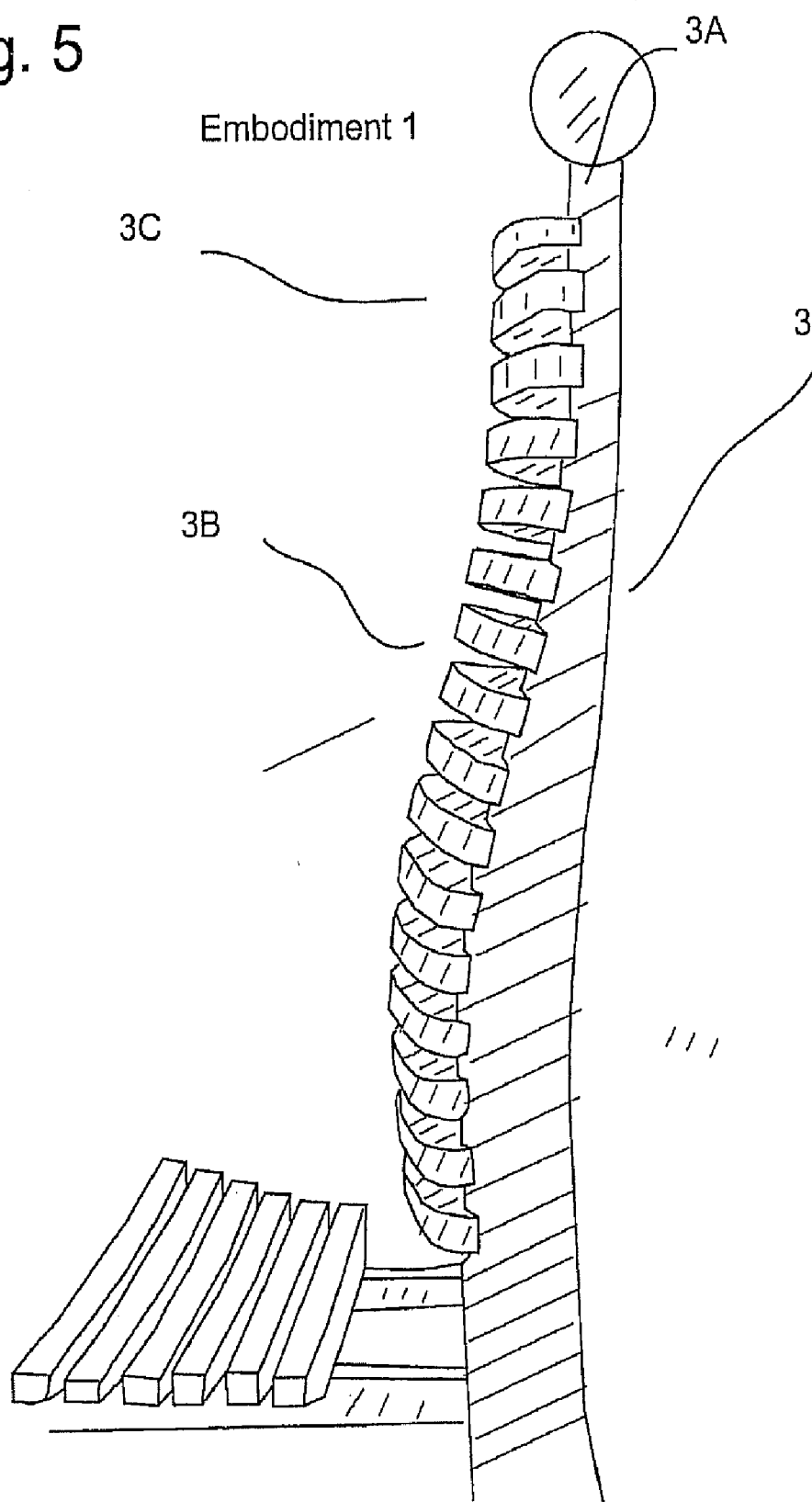


Fig. 6

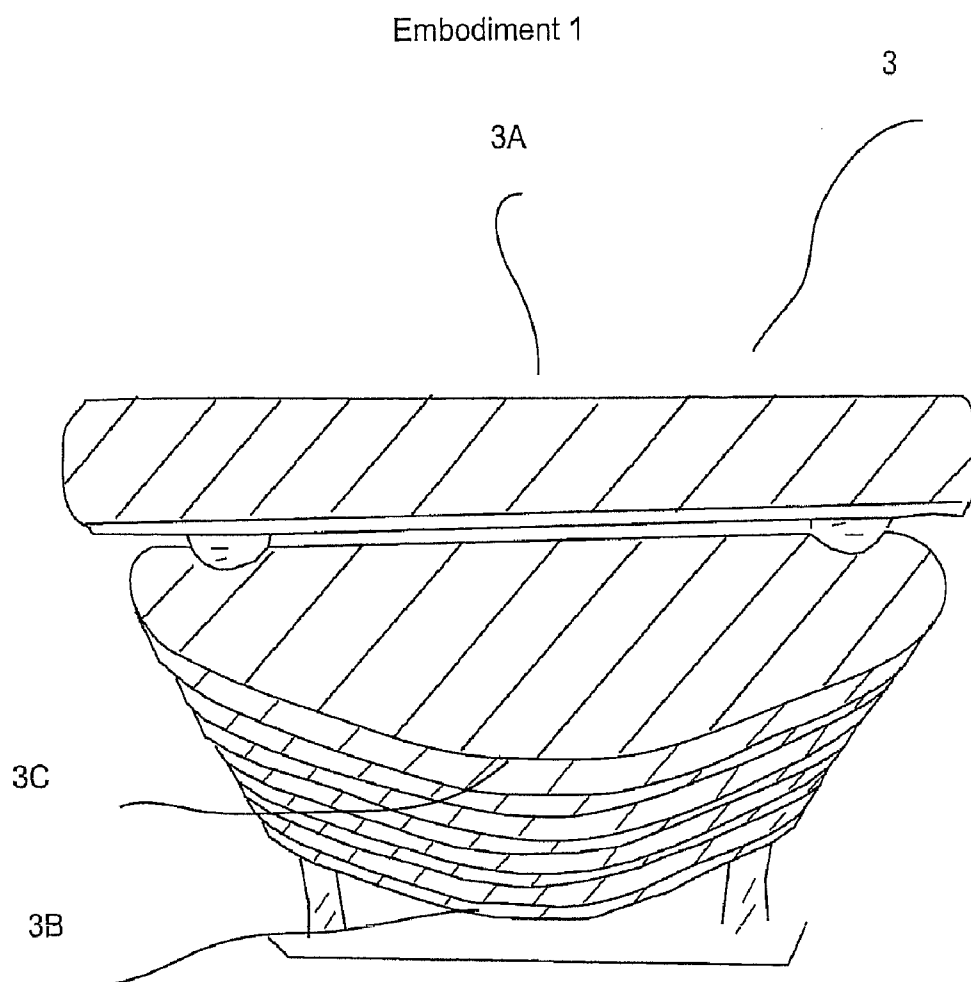


Fig. 7

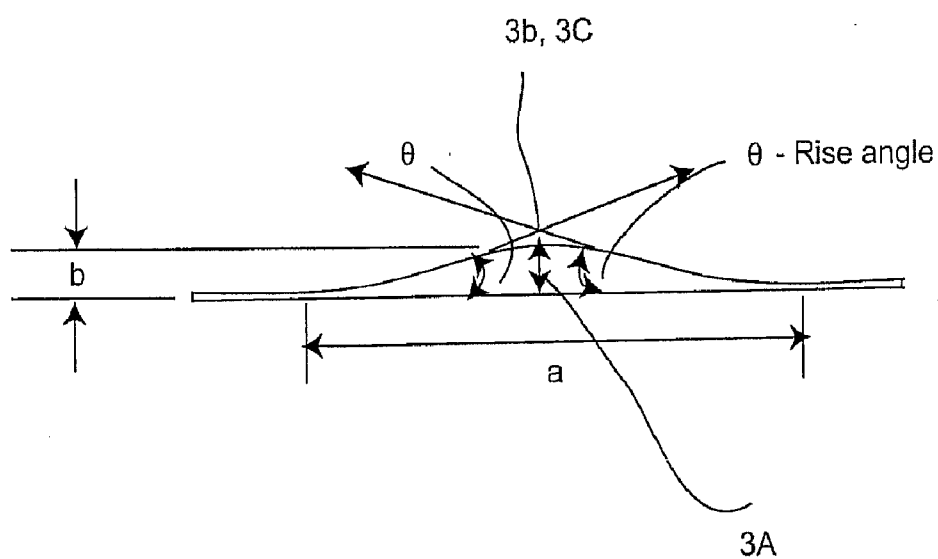


Fig. 8

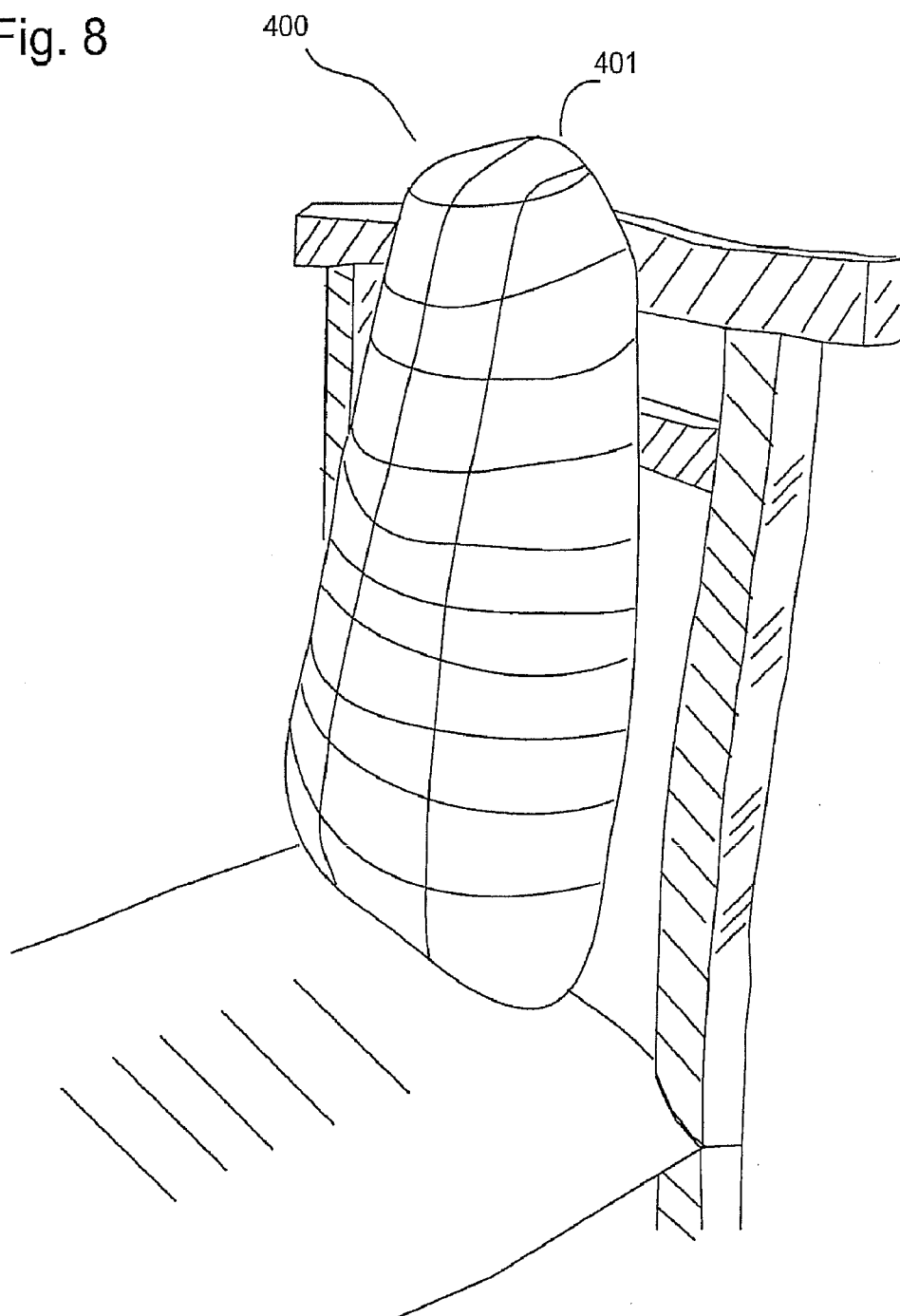


Fig. 9

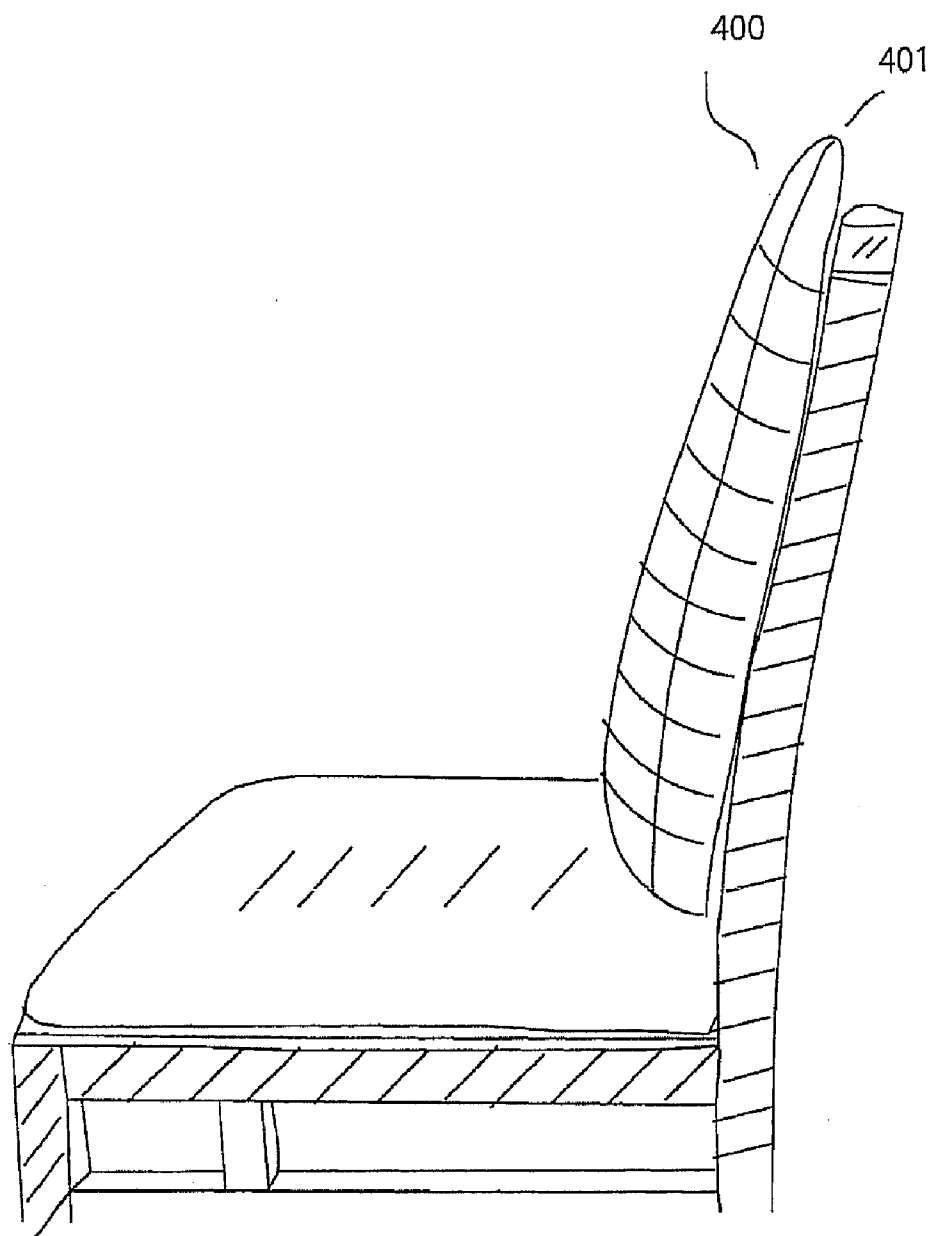


Fig. 10

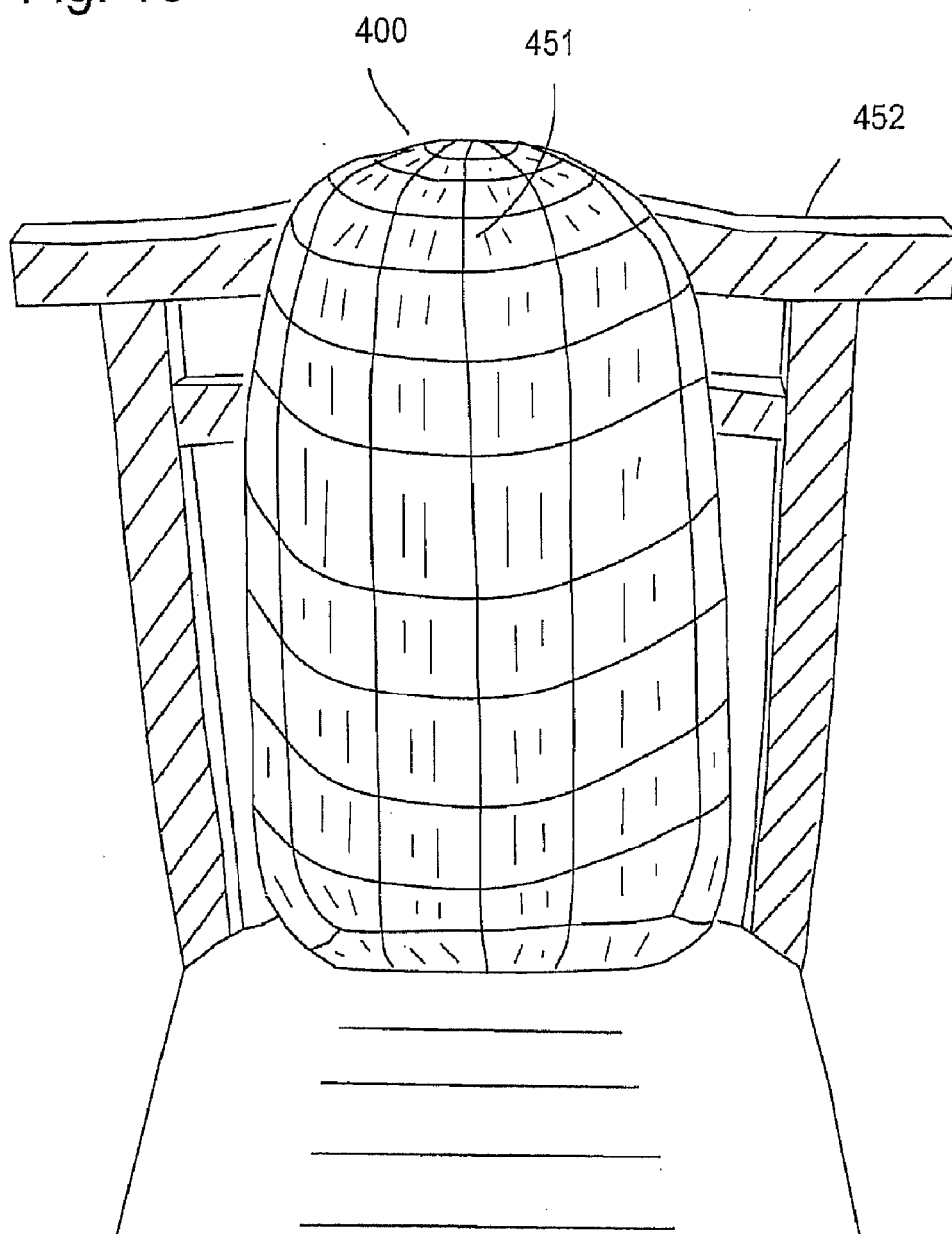


Fig. 11

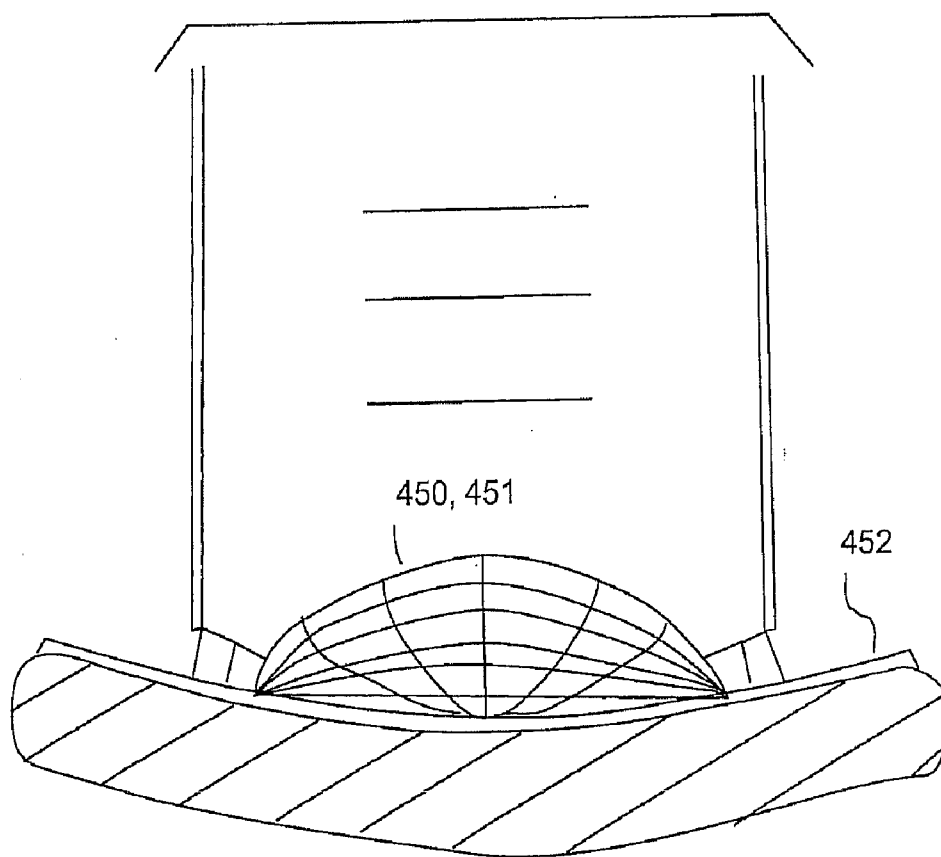


Fig. 12

Prior art

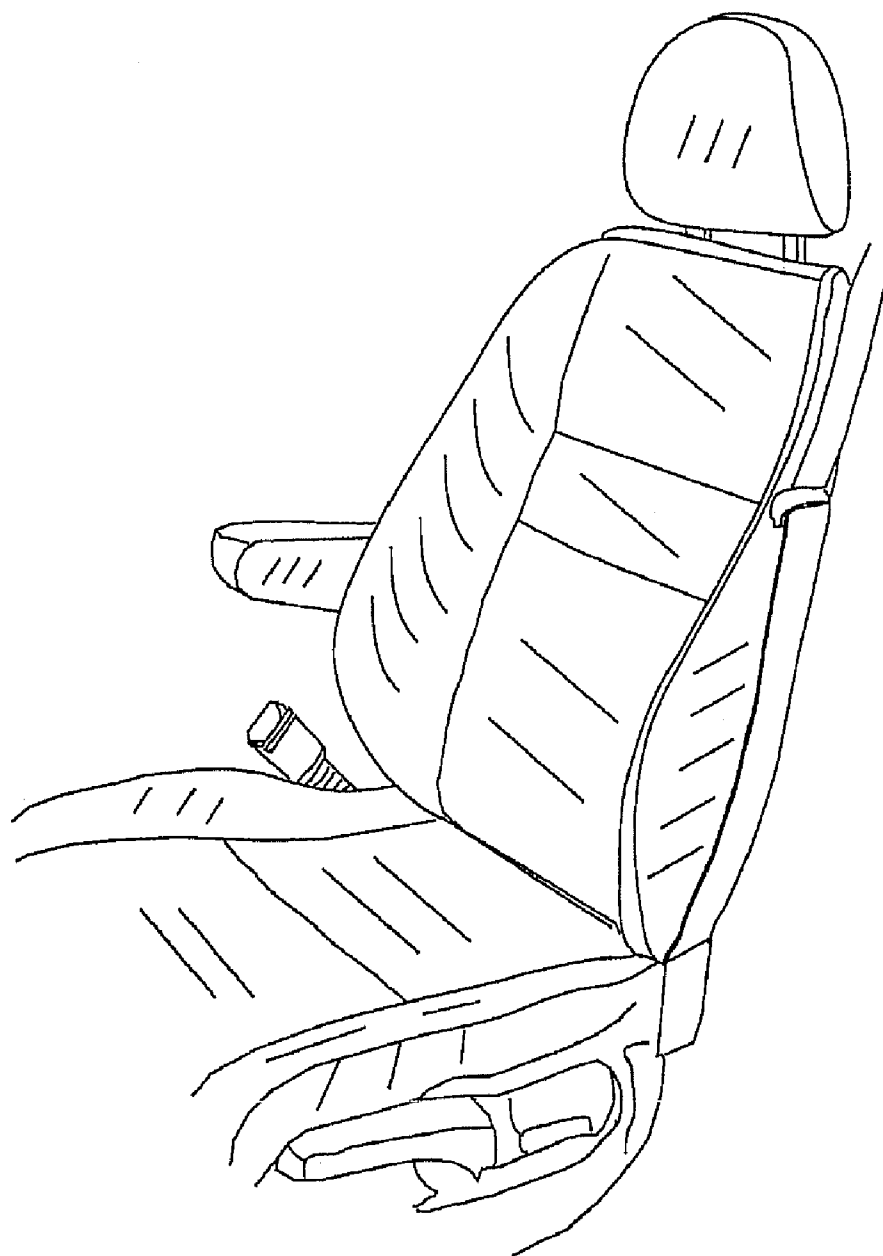


Fig. 13

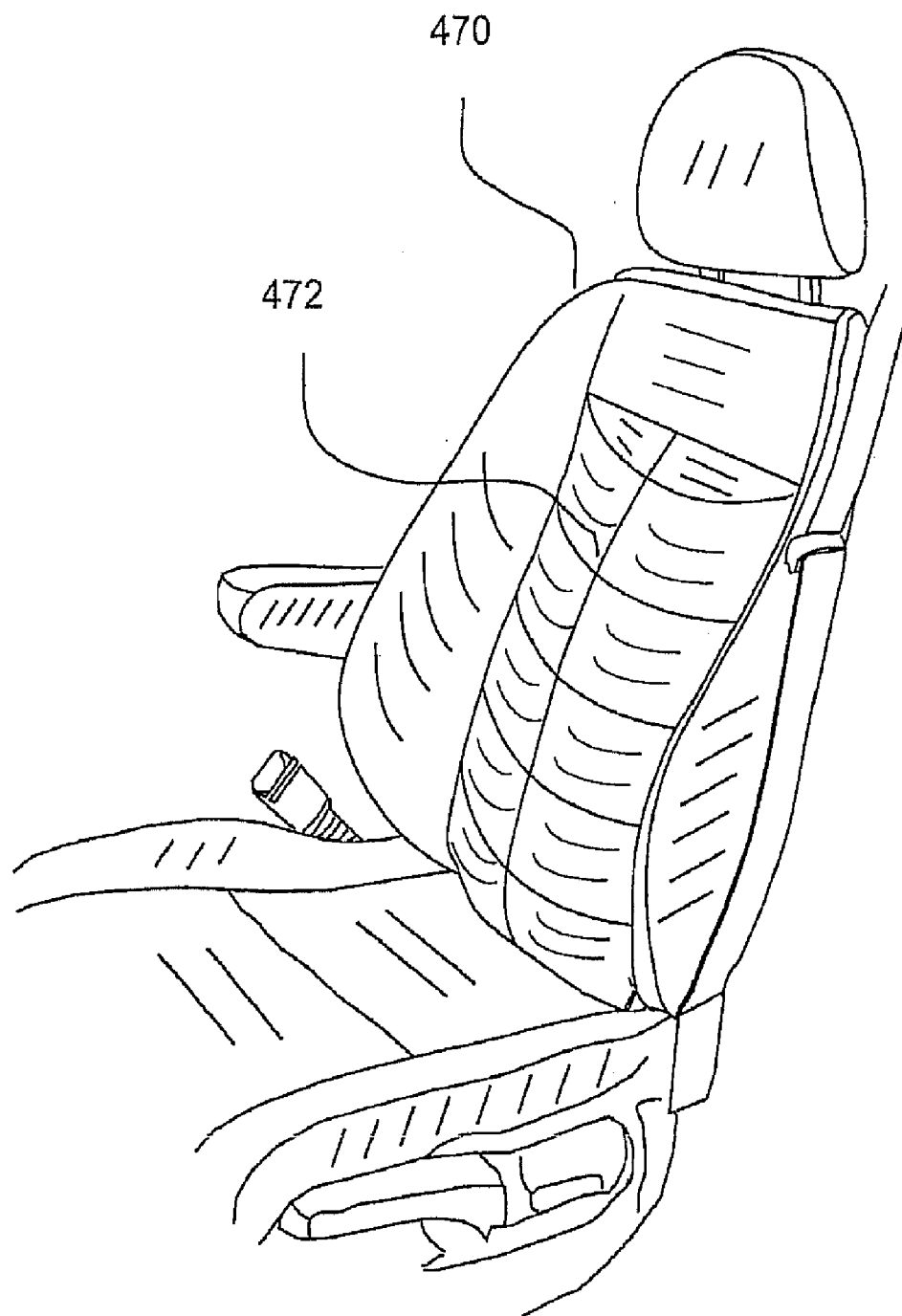


Fig. 14

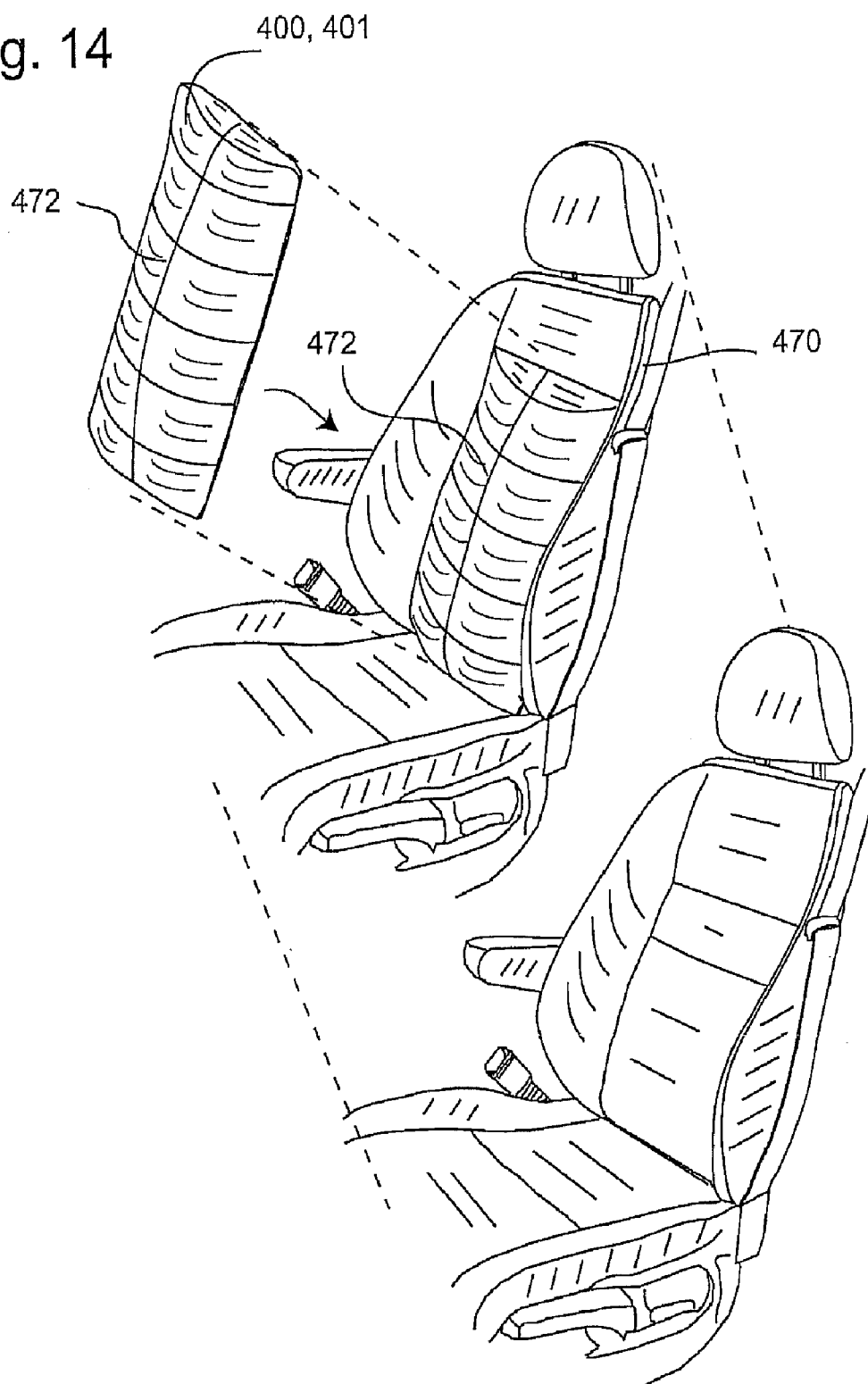


Fig. 15

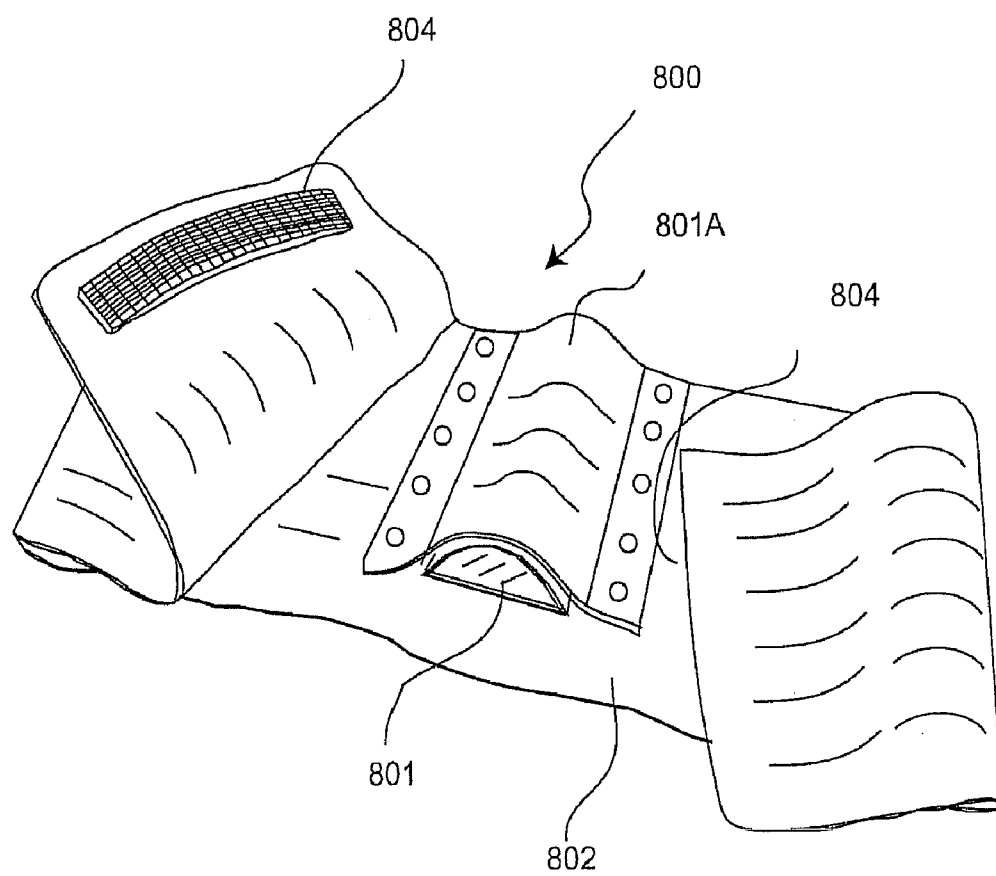


Fig. 16

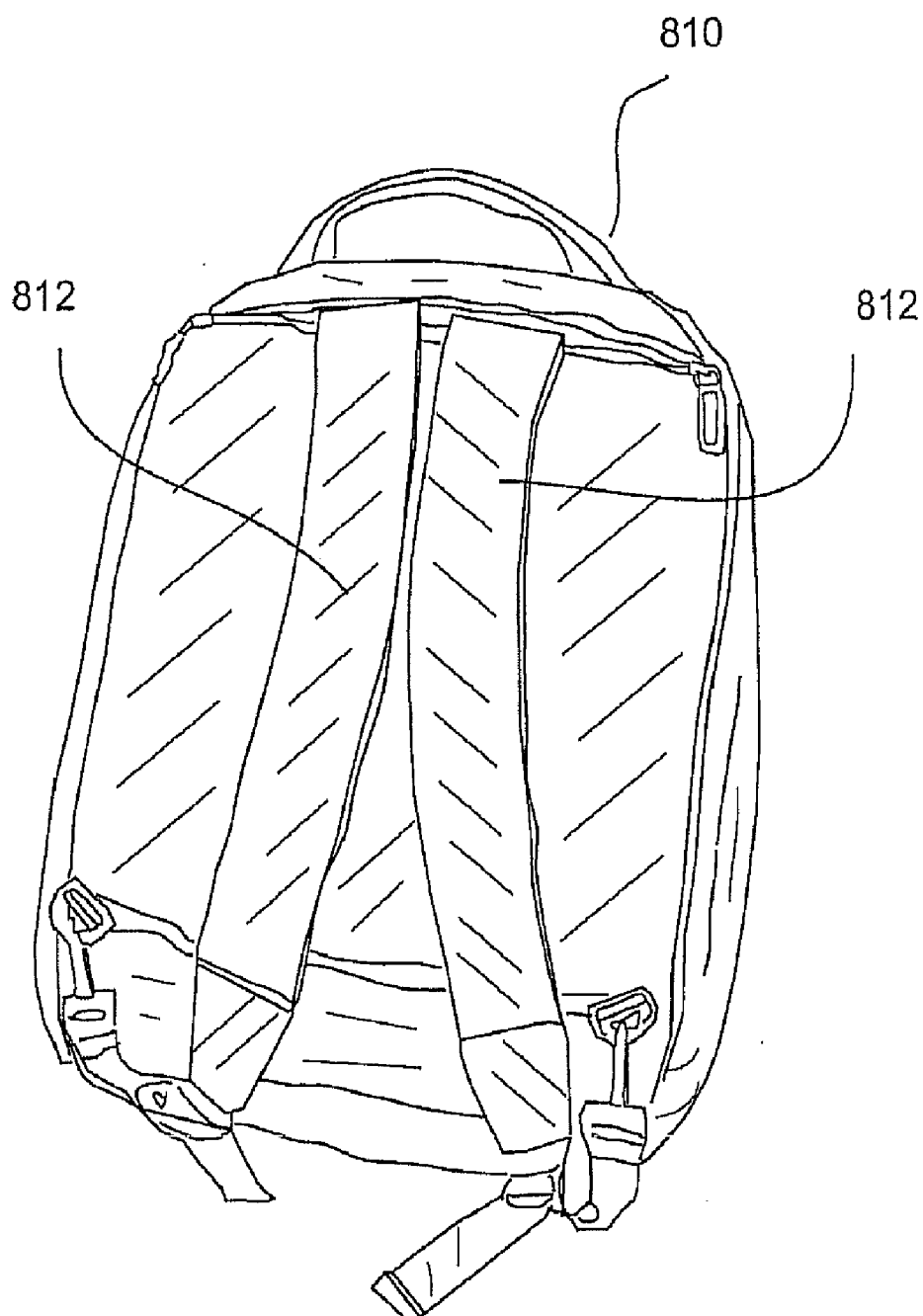


Fig. 17

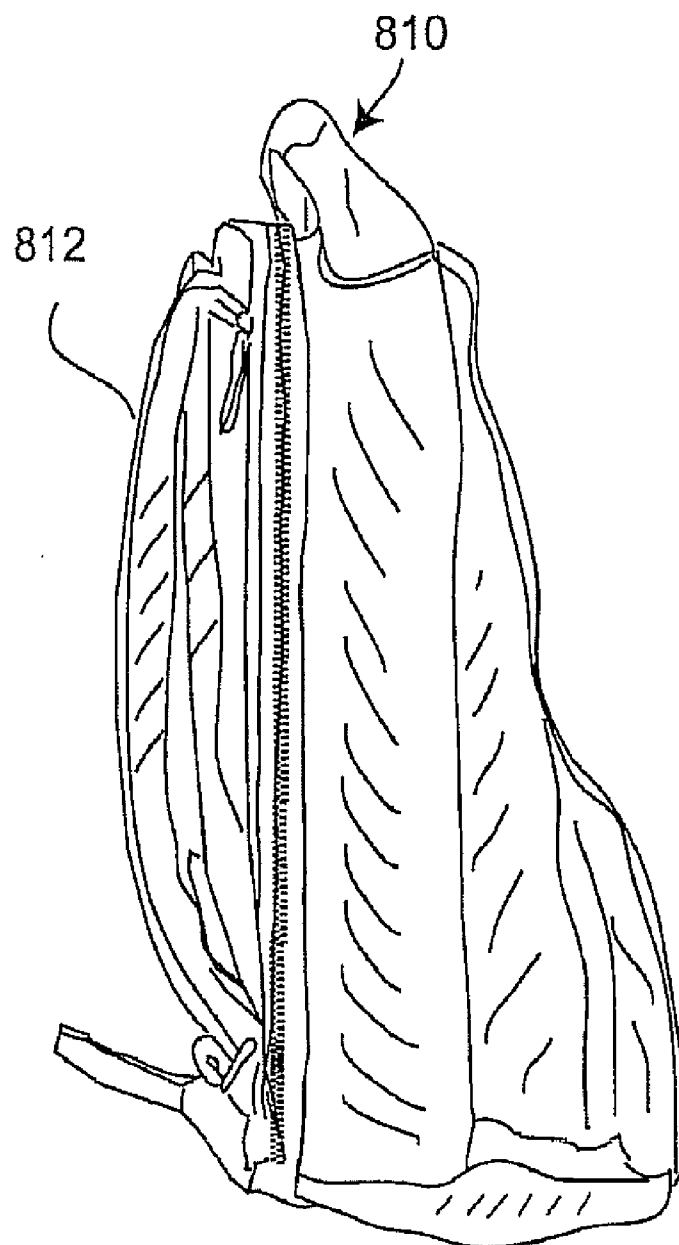


Fig. 18

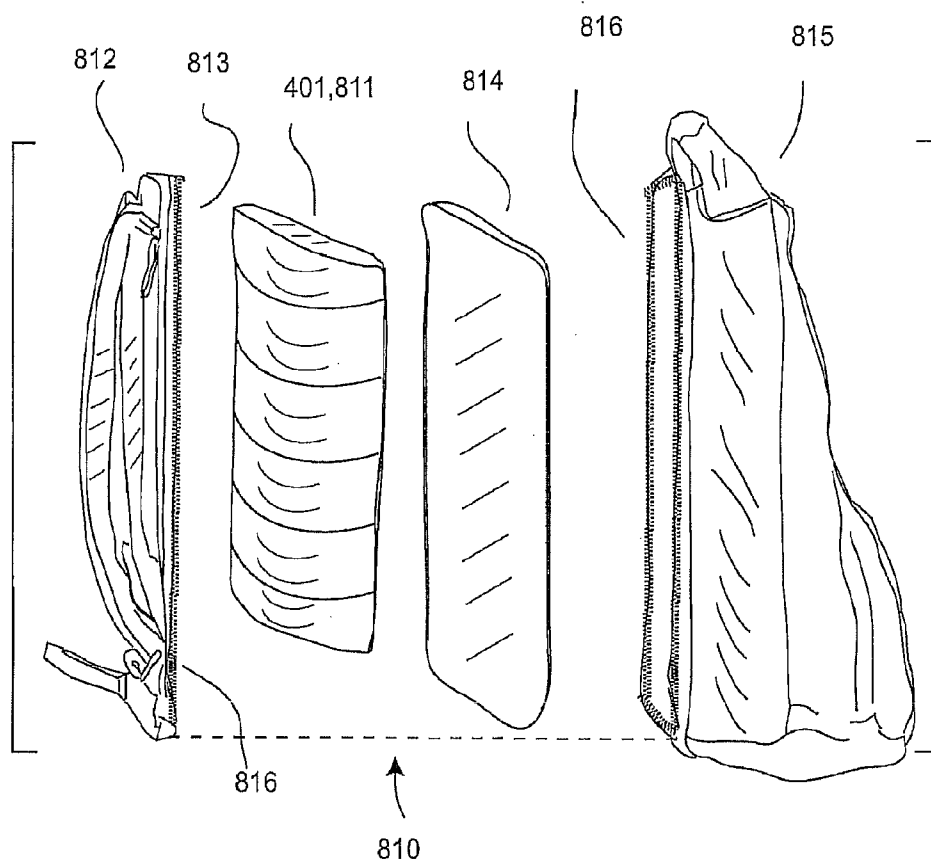


Fig. 19

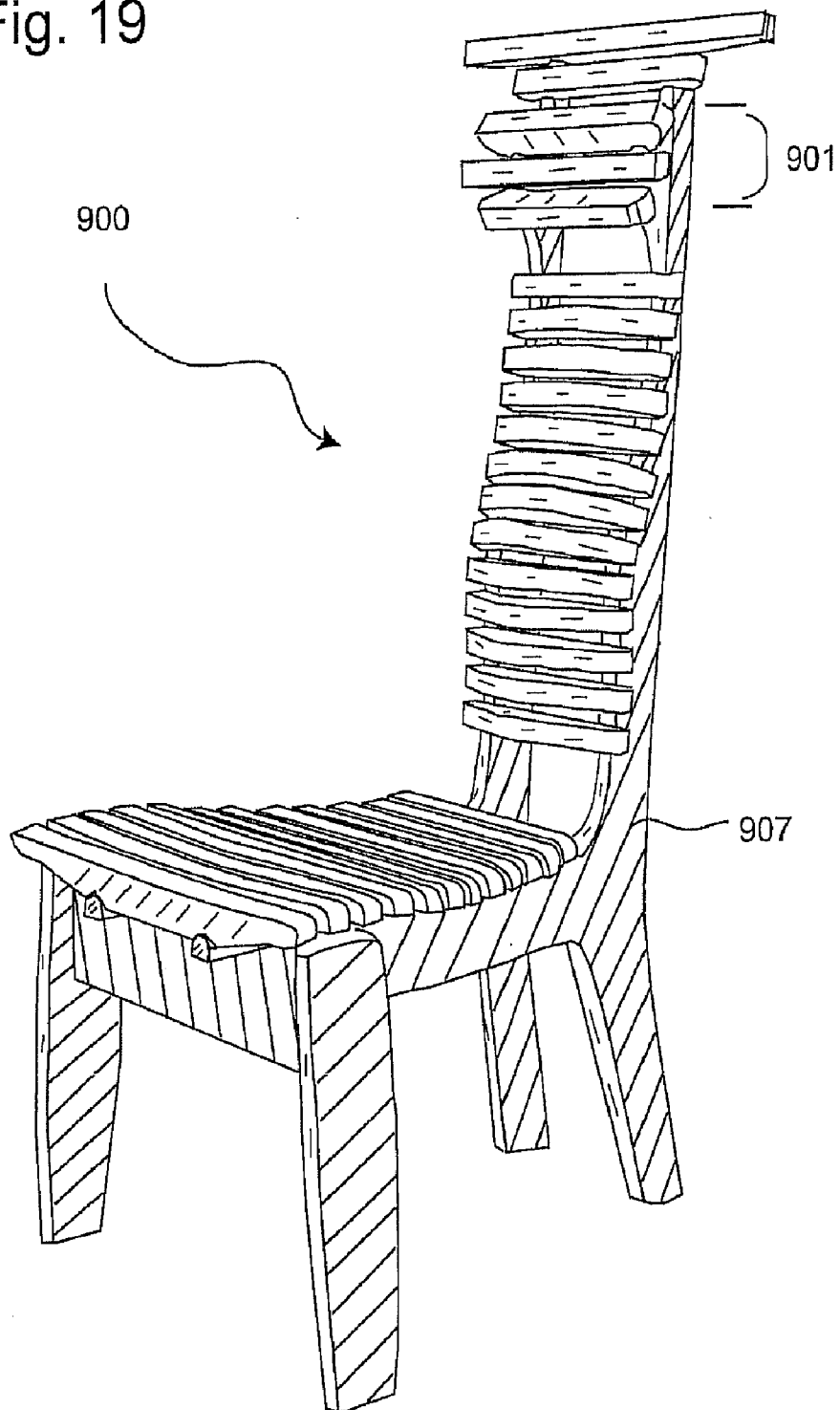


Fig. 20 Comparison Embodiment 1

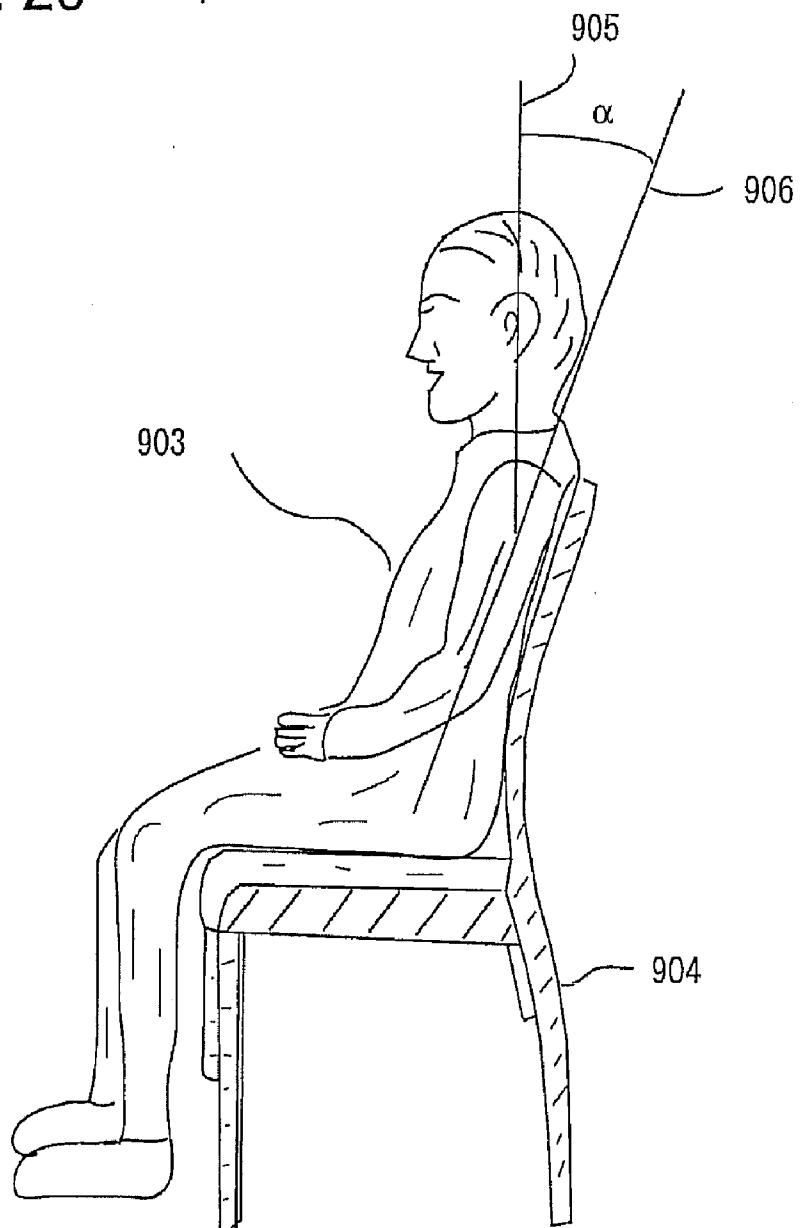


Fig. 21

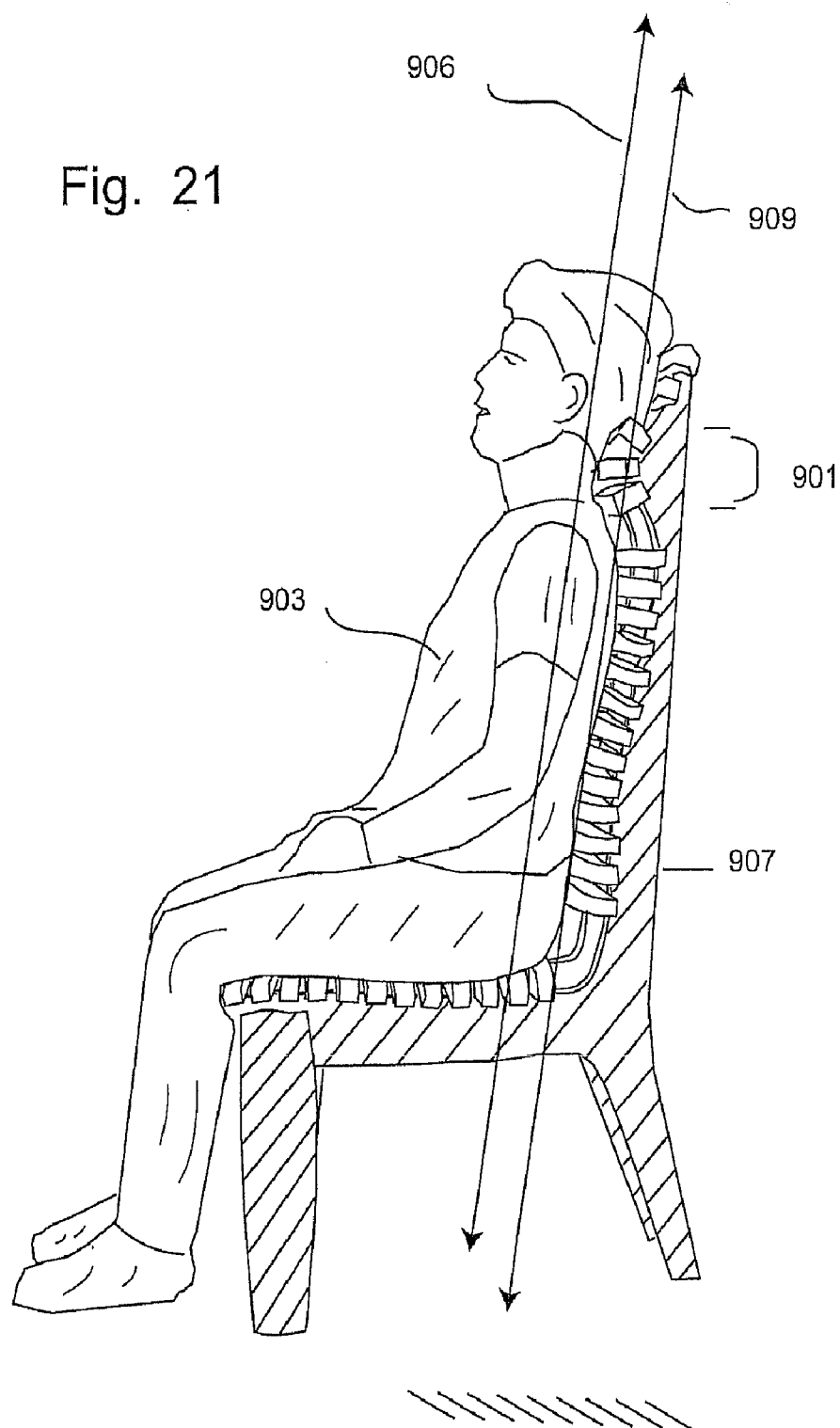


Fig. 22

Comparison embodiment 2
Prior art

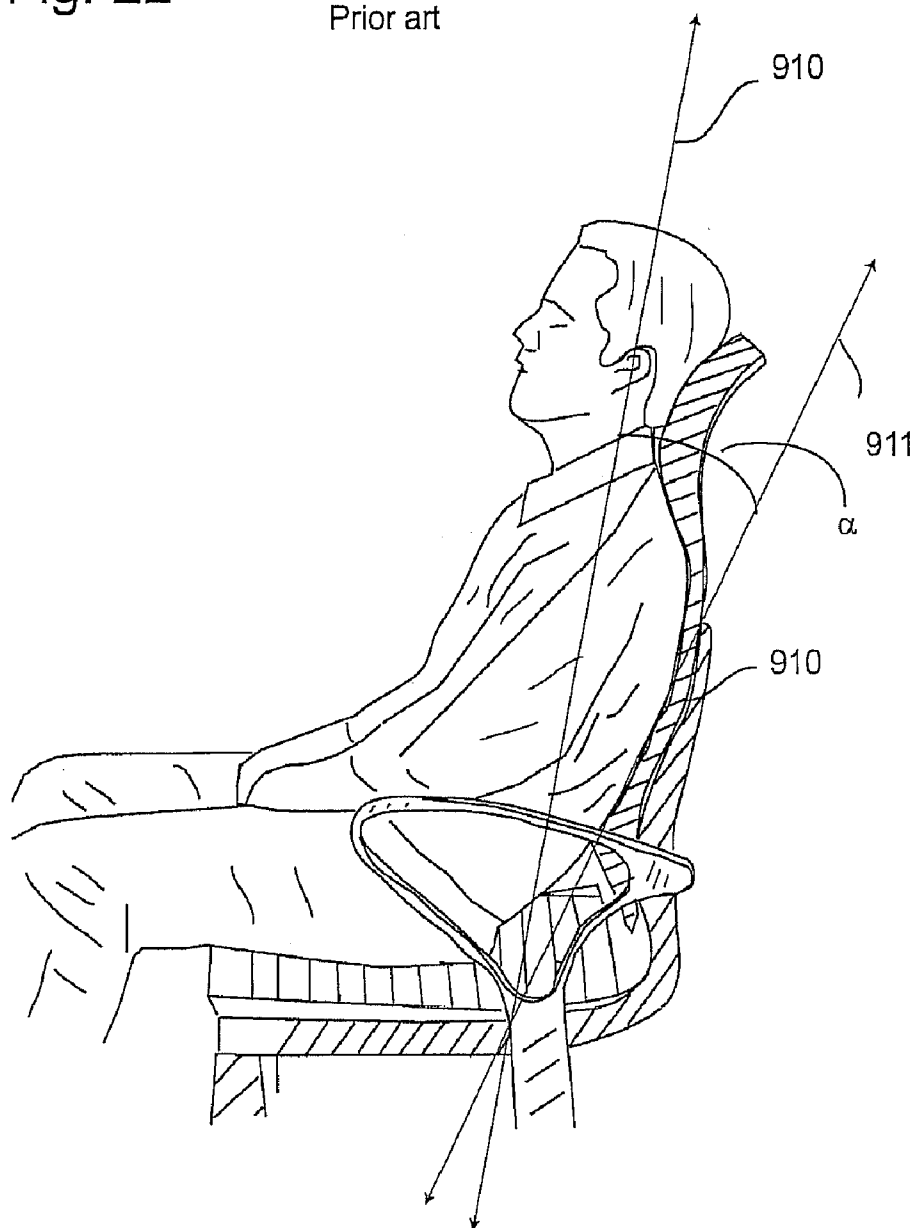


Fig. 23

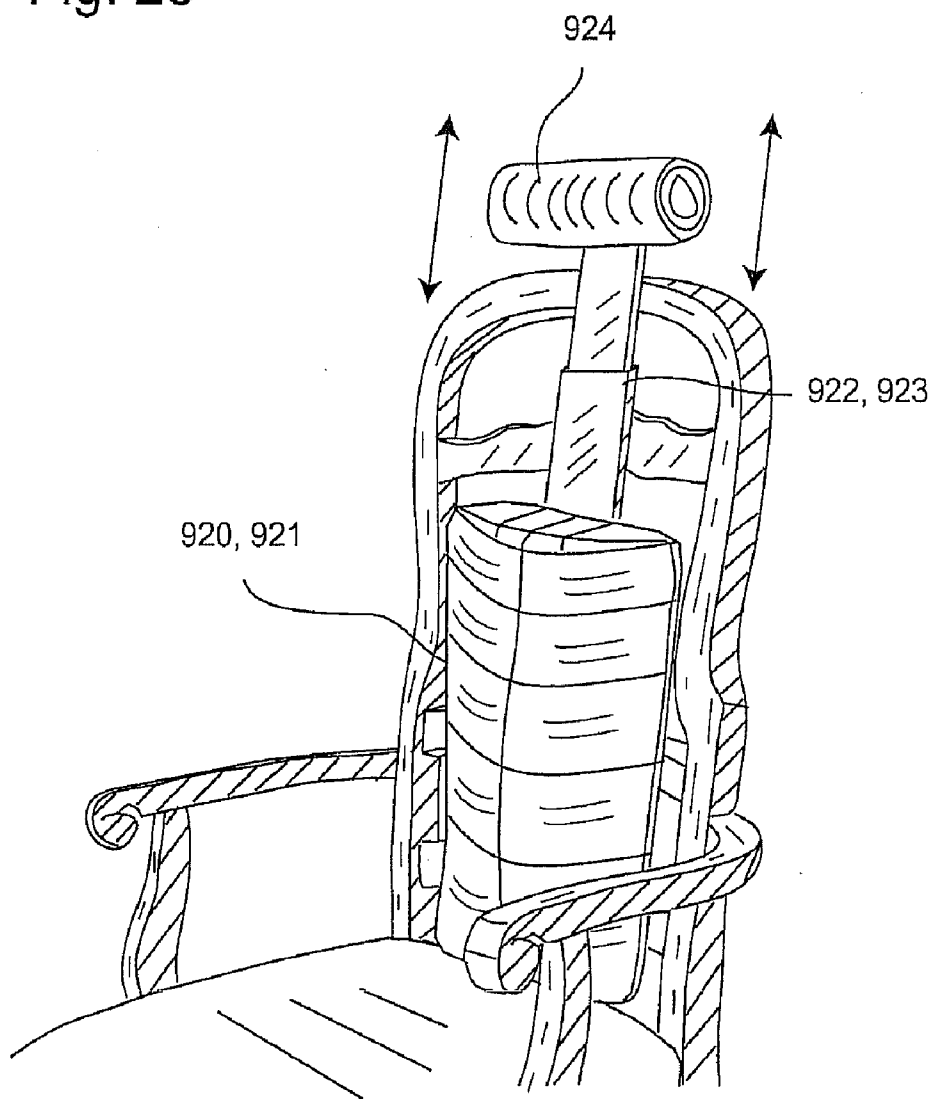
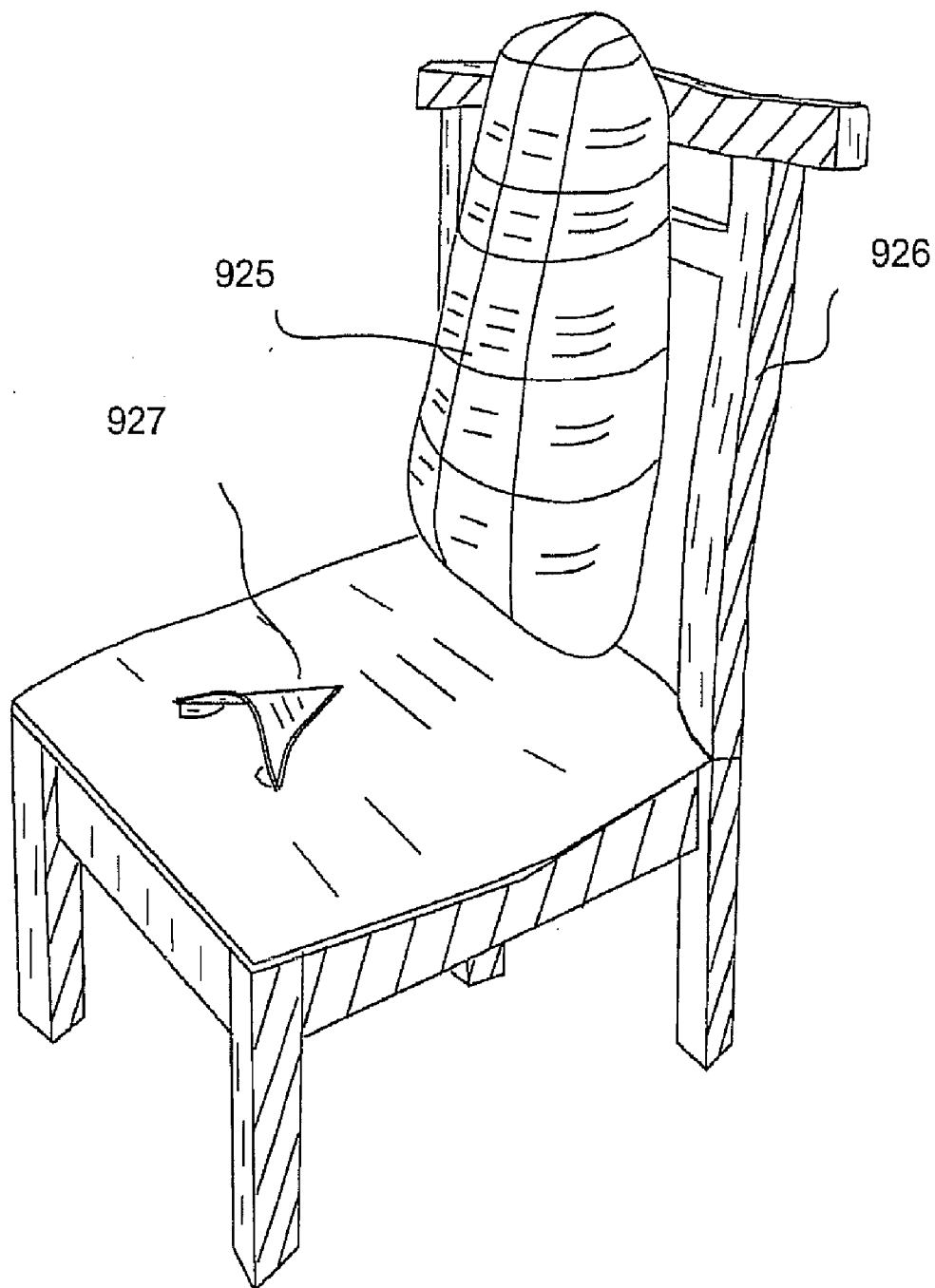


Fig. 24



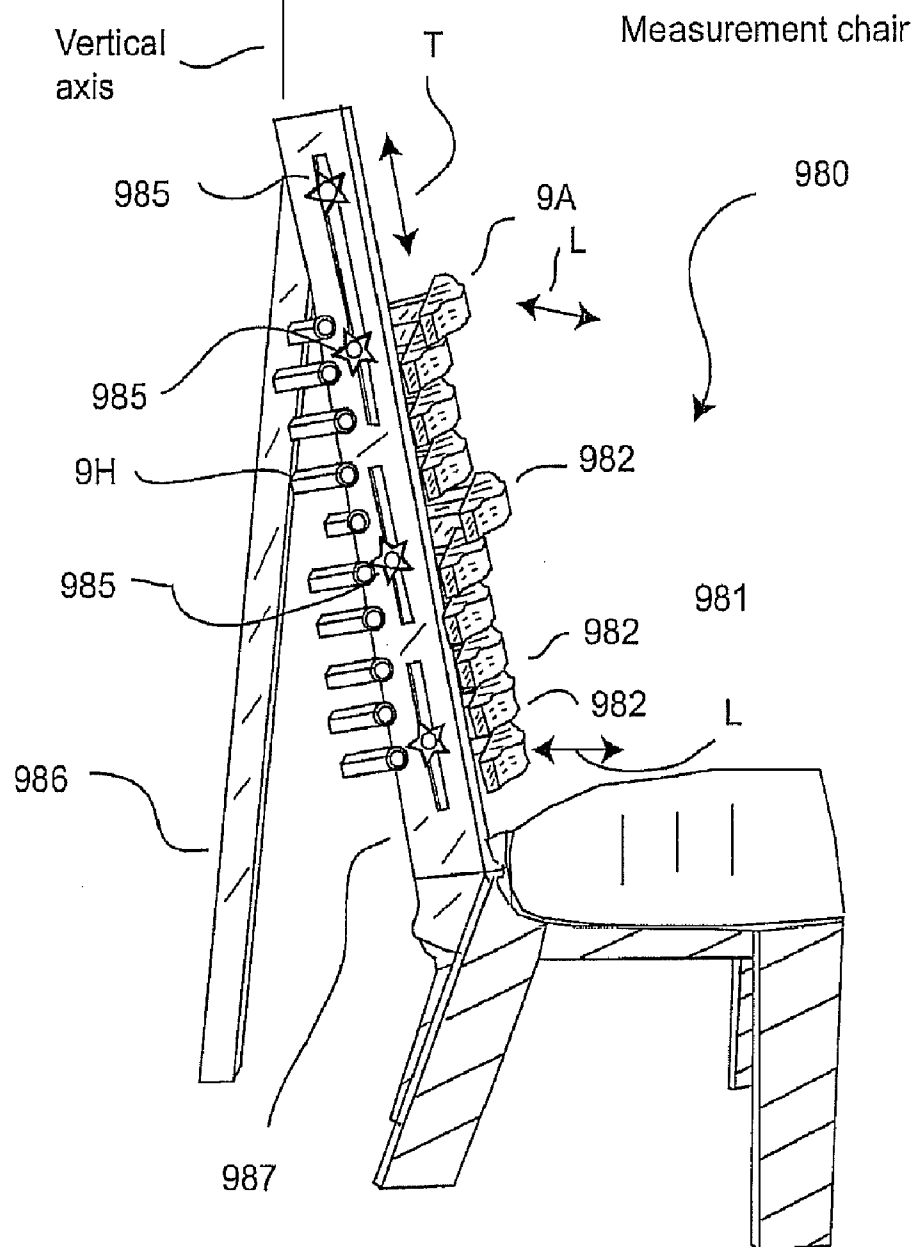
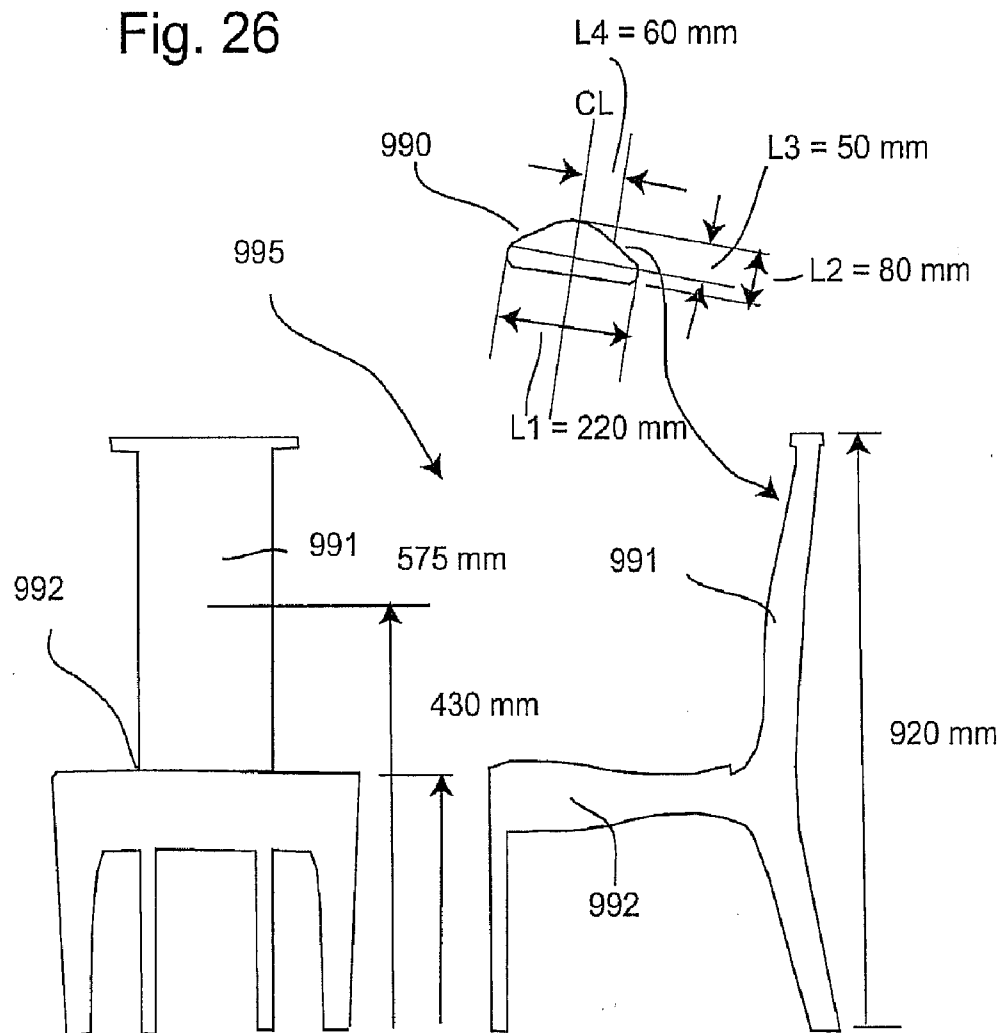


Fig. 26



BACK SUPPORT SYSTEM AND METHOD FOR IMPROVING THE SAME

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to U.S. Provisional Application Ser. No. 60/954,906 filed Aug. 9, 2007, and also from International Application PCT/US2008/072838 filed Aug. 11, 2008, the entire contents of each of which are herein incorporated by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a back support system that is fully rigid under the weight of a user. More specifically, the present invention relates to a comfortable and inexpensive back support system and method for the same, wherein the fully rigid back-support system provides projected and distended center liner support and curved portions from the surface on where a human being reclines or lies and requires back support.

[0004] 2. Description of the Related Art

[0005] Over time, human beings have inevitable problematic waist, back and neck discomfort (collectively back discomfort) resulting in fatigue and/or pain to the detriment of the human individual's quality of life and work performance. The related art involves proposed solutions to these inevitable human back frailties, including surgery, cushioned supports, and even non-support via so-called knee-type chairs, as will be discussed below.

[0006] To compensate for the pressures of standing and vertical orientation, the human spine has adapted a differing spinal column from other large mammals supported on four legs. In addition, the human neck is downwardly urged along a bending moment to the front because human head became heavier and heavier following the evolution of human brain and, with the spinal support at the rear of the skull, necessarily there is a cantilevered force along the skull-moment-arm under gravity to round the neck downwardly. Accordingly, humans are forced to pull their heads upwardly via musculature to see directly forward. Additionally, the human back, including musculature, is roughly flat instead of ridge shaped or bowed like that of other mammals. Finally, the bones of the spine are focused or orientated towards the front of the body from the back surface due to residual evolutionary effects of walking on all four limbs—e.g., the spinal bones include guiding spurs for protecting nerve endings and exhibit similar structural shapes as those of many four-footed animals. Thus, the human spinal construction has not yet fully adapted to an upright posture and over time this results in back pain for many.

[0007] It is generally recognized that modern-day humans are lying (horizontal) for one third of a day to sleep, sitting for half of a day to work, and two-thirds of a day in vertical orientation (sitting, walking or moving). Consequently, it is very important to keep the body's spinal posture at a "minimum tension" configuration to have well sleep and comfortable seating to minimize fatigues, unfortunately, the principal focus has not yet been recognized by those of skill in the art which has relied upon cushioned or resilient support (so called foam supports) to relieve this pressure. Unfortunately, this related cushioned support often causes further detrimental pain.

[0008] Further if body posture has been improper for a long period of time, the internal organs, such as a stomach, intestines and lungs, may be dysfunctional or limited in beneficial function.

[0009] Referring now to FIGS. 1 and 2, a conventional chair 1, even a very expensive chair, has a conventional waved shape 1B back support in vertical direction to provide some comfortableness rather than a flat surface. In addition, some expensive chairs also have an open-U-shape 1A in horizontal direction, shown along arch 1A' to provide a bucket-like or curving feature, which may prevent user's unintended body movement but unfortunately causes compression of the rib cage and pressure on internal organs and spinal column via force vectors 1A", 1A" positioned perpendicularly to the curve of arch 1A'.

[0010] Various attempts have been made to improve the noted detrimental conditions. In U.S. Pat. No. 4,529,247, the entire contents of which are incorporated herein by reference, the disclosure notes a one-piece shell chair with a tilt mechanism, but provides no rigid device for improving posture during sitting thereby limiting it as an effective solution to reducing pressure on internal organs.

[0011] In U.S. Pat. No. 4,601,514, the entire contents of which are herein incorporated by reference, disclosed is a backrest with a back support which might improve the lower back of the user but not upper back. In addition, although a huge number of chairs have been introduced and made, the back supports of such chairs are flat or open-u-shaped, or a so-called bucket seat. Even a racing car driver's seat of which necessarily requires extreme tensions during use and for long time periods, is a very tight U-shaped bucket seat having a related arc (like arch 1A' in FIG. 1) to minimize the body movement during race but fails to minimize spinal tension. The feature of such bucket seat may cause very strong stress to the driver's internal organs, particularly during the high gravitational loads applied during racing.

[0012] In US Pub. No. 2008/0116730 disclosed are the thoracic back support allowing for and assisting in the promotion of scapular retraction in a seated human. Unfortunately this reference realizes minimal column-only support for the upper spine portion or proximity of scapular. Further, the back support portion of '730 is flat and there is no force to push forwardly away from the spine as is discussed below. Accordingly, US '730 may not provide any force forward to help the straight posture and improve lower back tension and pain by forcing the middle of back in a manner discussed. If any force added to the column in '730 alone, the spine will be hurt due to direct back pressure on the spinal column itself.

[0013] What is not appreciated by the prior art therefore is a back support system and method for improving the same wherein the method readily speeds generation of the system.

[0014] Accordingly, there is a need for an improved back support system and method for generating the same.

OBJECTS AND SUMMARY OF THE INVENTION

[0015] An object of the present invention is to provide an adaptable and readily adjustable back support device that overcomes at least one of the detriments above noted.

[0016] Another proposed object of an alternative embodiment of the present invention is to provide an inexpensive and universal back support device and system that improves a user's pose and body shape.

[0017] Another proposed object of an alternative embodiment of the present invention is to provide a chair that releases a user's fatigue and provides comfortable position for the user over a long time period.

[0018] According to an embodiment to the present invention there is provided a chair with a back support means of the present invention. The back support device having a projection port in vertical direction approximately center of the back support may correct user's pose, improve fatigue, relief pressures to internal organs and minimize unintended body movement causing undesirable muscle tensions. In an alternative embodiment, a plurality of individually positionable spinal support members having a central undulation are positionable at variable and fixable distances along the vertical direction relative to the projection ports arranged there along according to the preferred ratios. For example, a plurality of members are positionable laterally relative to a generally upstanding support member to adapt to providing centralized support from a user's spinal column to the outers of the torso.

[0019] According to another embodiment of the present invention there is provided a seat back with a back support apparatus or device of the present invention, whereby the sides of a user's back are supported while the central column support also supports from the user's spine to the edges of the torso. The bucket type back support device of the present invention further improves to minimize body movement.

[0020] According to another embodiment of the present invention there is provided a car seat with the back support apparatus or device of the present invention. The car seat further improve the driver's fatigue and keeps the driver's best driving position and body pose throughout use improving driving safety.

[0021] According to another embodiment of the present invention there is provided a portable back support device of the present invention, which may be replacably positioned on almost any existing chairs to improve the user's pose, improve fatigue, relief pressures to internal organs and minimize unintended body movement causing undesirable muscle tensions. In addition, the portable back support device is less expensive and easily created by those of skill in the construction arts without undue difficulty.

[0022] According to another embodiment of the present invention, there is provided a back support belt, comprising a back support system, further comprising the belt having the undulating support members in the middle of belt to be positioned to the lower back of a user.

[0023] According to another embodiment of the present invention, there is provided a back pack, comprising a back support system inside the back pack. The portion of the back pack is separable from the main bag to be used as the back support system in a variety of occasions.

[0024] According to another embodiment of the present invention there is a chair with a back support device and a neck-rest to improve neck fatigue, pain and other complications.

[0025] According to another embodiment of the present invention there is a portable back support device having adjustable a neck-rest to improve neck fatigue, pain and other complications.

[0026] According to another embodiment of the present invention there is a seat having a means which may prevent body movement to the front with a back support system.

[0027] According to another embodiment of the present invention, a support system is provided that recognized the

spinal column may be supported in two directions (X and Y), relative to a Z-spinal column upright direction along the gravitational force, allowing the spinal column to assume a beneficial curve with support while forcing the user's rib cage to expand and not also compressing the muscles surrounding the spinal column.

[0028] According to another embodiment of the present invention, a back support system is provided comprising a rigid monolithic support member, the rigid support member having a substantially planar back surface and defining a support base surface arranged substantially perpendicular thereto and a top surface also arranged substantially perpendicular thereto and spaced from the support base surface by a distance divided into a first zone A, and a second zone B, in an upright arrangement in an external gravity field with the support base surface at a bottom location, the rigid support member having a height greater than a width defined along opposing sides of the upright length, a first continuous arc surface alpha defined distal from the substantially planar back surface and extending from support base surface to the top surface in a convex curve relative to the substantially planar back surface, a second continuous arc surface beta defined extending from opposing sides of edges denoting the width defined along the upright length in a convex curve relative to the substantially planar back surface, the alpha and beta arc surfaces interacting to form a continuously changing three-dimensional arc extending from the support base surface to the top surface and from opposing sides of the width defined along the upright length, an apex plane surface defined as extending from the substantially planar back surface to the alpha and beta arc surfaces and defining a separation between the first zone A and the second zone B, the apex plane surface defined at a location spaced from the base support surface by 20% of the distance to the top surface and having a maximum apex distance along a length of both alpha and beta arc surfaces, an apex of the convex curve relative to the base support surface being a distance X that is less than the maximum apex distance of the apex plane, by a ratio that is $X-1$, wherein $X-1$ is $0.90 > X-1 > 0.85$, and an apex of the convex of the convex curve about the top surface being a distance Y that is less than the maximum apex distance of the apex plane, by a ratio that is $Y-1$, wherein $Y-1$ is $0.60 > Y-1 > 0.50$, and whereby the rigid monolithic support structure provides a continuously curved rigid support to a back of an external user.

[0029] According to another embodiment of the present invention, a back support system is provided wherein: the continuous curve beta is at least a compound curve containing the sum of two radii defined at any reference position along the substantially planar back surface and extending perpendicularly therefrom, from the support base surface through the apex plane surface to the top surface, a line extending tangentially to each the curve formed by the radii and joining thereto forming the continuous curve beta along any the reference position, the ratio R-base of a minimum radii to a maximum radii of each respective defined curve at the support base surface being $0.65 > R\text{-apex} > 0.60$, and preferably 0.63, the ratio R-apex of a minimum radii to a maximum radii of each respective defined curve at the apex plane surface being $0.75 > R\text{-apex} > 0.70$, and preferably 0.73, and the ratio R-top of a minimum radii to a maximum radii of each respective defined curve at the top surface being $0.25 > R\text{-top} > 0.15$, and preferably 0.19.

[0030] According to another embodiment of the present invention, a back support system is provided, wherein: the

ratio R-base is preferably about 0.63, the ratio R-apex is preferably about 0.73, and the ratio R-top is preferably about 0.19, wherein the back support system enables a reduction in the compressive force exerted on a back of the external user employing the back support system. According to another embodiment of the present invention, a back support system is provided further comprising: an additional zone portion identified as a third zone C and extending from the defined top surface along the substantially planar back surface to a defined additional third top surface, the additional zone portion containing a third continuous arc surface alpha-1 defined distal from the substantially planar back surface and extending from defined top surface to the third top surface in a convex curve relative to the substantially planar back surface, an arc of the continuous arc surface alpha-1 being different than the arc of the continuous arc alpha, a fourth continuous arc surface beta-1 defined extending from opposing sides of edges denoting the width defined along the upright length in a convex curve relative to the substantially planar back surface between the defined top surface and the third top surface, an arc of the continuous arc surface beta-1 being different than the arc of the continuous arc beta, the alpha-1 and the beta-1 arc surfaces interacting to form a continuously changing three-dimensional arc extending from the top surface to the additional third top surface and from opposing sides of the width defined along the upright length, the third top surface extending from the substantially planar back surface to the alpha-1 and the beta-1 arc surfaces and defining an apex of the third top surface curve, the third top surface defined at a location spaced from the top surface a distance that is 80% of the distance between the support base surface and the top surface, whereby the third zone C substantially extends the upright dimension of the back support member, and an apex of the convex curve relative to the third top surface being a distance Z that is less than the maximum apex distance of the apex plane, by a ratio that is Z-1, wherein $Z-1$ is $0.40 > Z-1 > 0.30$, and the ratio Z-1 is preferably about 0.35.

[0031] The present invention relates to a chair with an improved back support system and method for adjusting and arranging the same. The back support device has an available projection port in vertical direction approximately centered on the back support that may correct a user's posture or spinal orientation via a plurality of fixed or positionable undulating curved supports. The proposed system and method improves user fatigue, relieves pressures to internal organs, and minimizes unintended body movement causing undesirable muscle tensions.

[0032] According to another embodiment of the present invention, there is provided a back support system, comprising: a plurality of undulating support members, and each of the individual undulating support member including a back reference plane and an undulating surface extending relative thereto from a first side to a second side, a midpoint region to each the undulating support member being spaced from the back reference plane a distance greater than non-midpoint regions between the first and the second side, means for vertically positioning the plurality of undulating support members relative to each other along a vertical reference direction, and means for individually securing each the undulating support member in a position independently from respective other undulating support members, whereby the back support system allows individualized positioning and securing of respective the undulating support members along both a first lateral direction away from the vertical reference

direction and a second vertical direction thereby allowing improved positioning of a plurality of undulating support members.

[0033] According to another embodiment of the present invention, there is provided a chair, comprising: a back support system, further comprising: a plurality of undulating support members, each of the individual undulating support member including a back reference plane and an undulating surface extending relative thereto from a first side to a second side, a midpoint region to each the undulating support member being spaced from the back reference plane a distance greater than non-midpoint regions between the first and the second side, means for vertically positioning the plurality of undulating support members relative to each other along a vertical reference direction, and means for individually securing each the undulating support member in a position independently from respective other undulating support members, whereby the back support system allows individualized positioning and securing of respective the undulating support members along both a first lateral direction away from the vertical reference direction and a second vertical direction thereby allowing improved positioning of a plurality of undulating support members.

[0034] According to another embodiment of the present invention, there is provided a method for arranging a back support system relative to a back of a user, comprising the steps of: providing a first support structure having a user support member and an upright reference direction member, providing a plurality of undulating support members, each of the individual undulating support members including a back reference plane and an undulating surface extending relative thereto from a first side to a second side, a midpoint region to each the undulating support member being spaced from the back reference plane a distance greater than non-midpoint regions between the first and the second side, providing means for vertically positioning the plurality of undulating support members relative to each other along a vertical reference direction, and providing means for individually urging and securing each the undulating support member in a position independently from respective other undulating support members, whereby the back support system allows individualized positioning and securing of respective the undulating support members along both a first lateral direction away from the vertical reference direction and a second vertical direction thereby allowing improved positioning of a plurality of undulating support members.

[0035] The above, and other objects, features and advantages of the present invention will become apparent from the following description read in conjunction with the accompanying drawings, in which like reference numerals designate the same elements.

BRIEF DESCRIPTION OF THE DRAWINGS

[0036] FIG. 1 is a perspective view of a conventional chair.

[0037] FIG. 2 is a side view of the conventional chair in FIG. 1.

[0038] FIG. 3 is a back figure of a human being denoting various reference details and orientation details.

[0039] FIG. 3A is a representative and pictorial force analysis from a vertical view along a spinal axis of a seated human for the preferred embodiment of the present invention. A number of force vectors are noted.

[0040] FIG. 3B is a combined pictorial view of a top and side views of the preferred embodiment module for support, noting specific ratios and measurements.

[0041] FIG. 3C is a side elevational view of a preferred embodiment including an optional extension portion above the middle back in an additional zone of support.

[0042] FIG. 3D is a combined elevational view with a photo of a representative embodiment of the present invention noting that the preferred curvature of support may be provided in proportional intervals of support along respective height changes relative to a floor or a seating level of a chair.

[0043] FIG. 3E is a descriptive graphic of the pictorial information provided in FIG. 3D, wherein the proportional intervals are equivalent and there are horizontal extensions (perpendicular from a vertical defined from the floor) extending along various distances as within the boundaries of the embodiment noted in FIGS. 3B and 3C.

[0044] FIG. 4 is a perspective view of a first embodiment of the present invention.

[0045] FIG. 5 is a side view of Embodiment 1 in FIG. 4.

[0046] FIG. 6 is a top view of Embodiment 1 in FIG. 4.

[0047] FIG. 7 is a rational expression of the projection from the back surface, noting the central extension and general undulating construction with convex angles Φ on either side in contrast to the concave understanding in the related art.

[0048] FIG. 8 is a perspective view of an alternative Embodiment 2 of the present invention.

[0049] FIG. 9 is a side view of Embodiment 2 of the present invention in FIG. 8.

[0050] FIG. 10 is a front view of Embodiment 2 of the present invention in FIG. 8.

[0051] FIG. 11 is a top view of Embodiment 2 of the present invention in FIG. 8.

[0052] FIG. 12 is a perspective view of a conventional car seat noting the concave (shell-type) support along the spinal region of a user.

[0053] FIG. 13 is a perspective view of Embodiment 3 of the present invention installed on the conventional seat of FIG. 12.

[0054] FIG. 14 is a pictorial explosive view of Embodiment 3 of the present invention noted in FIG. 13 illustrating the change in construction.

[0055] FIG. 15 is a perspective view of Embodiment 4 of the present invention as a back-support wrap with closure mechanism.

[0056] FIG. 16 is a back perspective view of Embodiment 5 of the present invention as a back-supporting backpack apparatus.

[0057] FIG. 17 is a side view of Embodiment 5 of the present invention in FIG. 16.

[0058] FIG. 18 is an explosive view of Embodiment 5 of the present invention in FIGS. 16 and 17.

[0059] FIG. 19 is a perspective view of Embodiment 6 of the present invention now including a continuous or discontinuous a neck-rest portion adapted to Embodiment 1 of FIG. 4, discussed earlier.

[0060] FIG. 20 is a side view of the conventional chair with a seated user from FIG. 1, as a comparison embodiment 1.

[0061] FIG. 21 is a side view of Embodiment 6 with a seated user in FIG. 19.

[0062] FIG. 22 is a side view of Comparison Embodiment 2 of conventional seat having a neck-rest.

[0063] FIG. 23 is a perspective view of Embodiment 7 of the present invention.

[0064] FIG. 24 is a perspective view of another Embodiment 8 of the present invention including the device with a sliding stopping means minimizing a user's sliding transition along a chair seat surface and away from the specific support provided, thereby allowing spinal-muscle relaxation.

[0065] FIG. 25 is an alternative embodiment of the invention providing a set-up system for positioning the respective individual support members along a horizontal movement range and a vertical movement range relative to a support surface so as to adjust a position of the specified support according to a user's height and physical structure.

[0066] FIG. 26 is an illustrative view of an item resulting from the use of the set-up system noted in FIG. 25.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0067] Reference will now be made in detail to several embodiments of the invention that are illustrated in the accompanying drawings. Wherever possible, same or similar reference numerals are used in the drawings and the description to refer to the same or like parts or steps. The drawings are in simplified form and are not to precise scale. For purposes of convenience and clarity only, directional terms, such as top, bottom, up, down, over, above, and below may be used with respect to the drawings. These and similar directional terms should not be construed to limit the scope of the invention in any manner. The words "connect," "couple," and similar terms with their inflectional morphemes do not necessarily denote direct and immediate connections, but also include connections through mediate elements or devices.

[0068] Referring now to FIG. 3, a human back-shape is multi-dimensional, and includes an open-U-shape 2L (a part of oval-shape torso extending away from and along the projecting spinal muscles), and also a shallow V-shaped cavity 2K spaced between the projecting spinal muscles. Specifically, a horizontal human back-shape is not simple open-U-shape but is a waved-W-shape (from one side to the other with the center of the "W" being the shallow V-shaped cavity 2K).

[0069] Referring now to FIG. 3A a representative analysis of a force construction is noted relative to a spinal axis 100 as shown for a human user 101 having a head member (shown), and a torso boundary line (shown) as well as an exemplary rigid non-deflecting support device 102 according to the present invention.

[0070] As will be noted, parallel sets of analysis along force lines f , f' are determined as weight of body on opposite sides of spinal axis 100 pushing (while seated) onto the rigid non-deflecting support surfaces for device 102. As will be noted a key is provided for the force vectors f , $f1$, $f2$, $f3$, $f1'$, $f2'$ and $f3'$, as respectively shown in the diagram. It is noted that forces $f3'$, $f3'$ are the opposing resulting forces and the resulting vector sum of tangent forces $f2'$, $f2'$ are the outward forces $f1'$, $f1'$ which, due to their size, are illustrative of the rotational (opening) force exerted on the seated user 101 to open the lungs and torso cavity and result in less pressure ($f3'$, $f3'$) being pushed back into the user from the back support. In sum, forces $f3'$, $f3'$ are resulting in less or lowered pressure returning from the back support into the user due to the unique shape and size, and critically the rigidity or non-deforming nature of support 102. Those of skill in the art, having studied the attendant disclosure in detail, will recognize that the rigid non-deflecting nature of support 102 enables the above force-analysis. Were support member 102 to be deforming it would be impossible to achieve the present results. As noted above,

a deforming support would curve the torso of the user and would result in a contrary analysis. Referring now to FIGS. 3B and 3C, a preferred support embodiment **102** is noted, and an additional extension support portion **102'** (see FIG. 3C) is noted. As depicted the preferred width is 260 mm (millimeters) and a preferred length of 500 mm, broken into a Zone A (100 mm) and a Zone B (400 mm), as shown. Each support **102**, **102'** includes a front user-contacting surface **102A** and a rear chair-surface or bracing contacting surface **102B**. For example, during a use, supports **102**, **102'** may be placed in a conventional chair (shown later) or against another bracing contacting surface which in turn contacts contacting surface **102B**, and being a non-deforming rigid member transfers this support to user-contacting surface **102A**. Measurements noted are as shown or are relative to these discussed surfaces.

[0071] As will be noted a base surface **102C** is provided with a center height of 83 mm (preferable), and a top height of 95 mm (preferable) forming Zone A or the lumbar support portion. It is noted that Zone B is a mid-back support range. Necessarily, a parallel arc curve extends from outer perimeter of the 260 mm width to the apex and returns on the opposing side uniformly in an arc, which in combination forms an 'arch' for supporting the user's back. Beginning in Zone B, a top surface **102D** with a height of 50 mm (preferably) extends downward to meet the apex of 95 mm (preferable) at the beginning of zone A. As a result of the depiction and the illustrations in FIGS. 3B and 3C it will be understood that there is both a major curve Alpha from top and base surfaces **102D**, **102C**, and a minor curve Beta from side to side across the width of 260 mm (preferably). Thus, there are two principal curves that are smoothly blended together and may be understood by the dimensions noted and the below discussed ratios relative to the back-support surface **102B** and front surface **102A**.

[0072] As noted in FIG. 3C and additional extension for upper back and neck, in Zone C, extends an additional 400 mm (preferably) to a narrowing arch having an apex at 34 mm (preferable) from support surface **102B**.

[0073] Preferably, it will be noted, that with back support plain **102B** being a common plane among zones A, B, and C, that there is a recognized centerline "CL" along line **102B'** that traverses the length of member **102** from zone A to zone C (after combination) and provides a reference for further discussion. A point at **102B"** is the intersection between centerline **102B'** and back support plane **102B**, allows a discussion of radii for generating an understanding of the curve limitations between outer points **102B-1** and **102B-2** along the outer edge of bottom plane **102B** (see FIG. 3B). These radii (R) details will be recognized as being between R=95 mm to 130 mm, in Zone A, between R=50 mm to 130 mm, in Zone B, and between R=34 mm to 130 mm in Zone C. Such that the continuous curve (curve Beta) is formed by the arc-tangents between the two respective curves defined along the peak center line radius and the bottom plane radius. In this way a continuous convex curve is extended from point **102B"** with a variable range of ratios forming the outer back-support surface.

[0074] Additionally in this way, it will be realized that for Zone A, a height ratio from bottom **102C** (83 mm high) to top location **102C'** (95 mm high) is $0.87(=(83-95)/95)$, so that the tapered reduction in the arc curve change (curve Alpha) or reduction of approximately 12.6% (=12 mm/95 mm) from the top location **102C'**.

[0075] For Zone B, it will be recognized that the height ratio from top location **102C'** (95 mm high) to the top plane **102D** of Zone B (50 mm high), is $0.53(=(50-95)/95)$, so that there is a tapered reduction in the arc curve change (curve Alpha) or reduction of approximately 47% (=45 mm/95 mm) from the apex or highest curve position.

[0076] For optional Zone C, it will be recognized that the height ratio from top location **102C'** (95 mm) to the top plane at the end of Zone C (34 mm high), is $0.35(=(95-34)/95)$, so that there is a tapered reduction in the arc curve (curve Alpha) of approximately 64% (=61 mm/95 mm) from the apex or highest curve position. It will additionally be noted that the ratio is approximately $0.32(=(50-34)/50)$ for the change from Zone B to Zone C and an arc curve change or reduction of approximately 45.7% (=16 mm/34 mm) from the now apex of **102D** at the top of Zone B. Therefore, Zone C provides a change between smooth curve from the apex at 95 mm to 34 mm and optionally a different curve from 50 mm to 34 mm (as shown).

[0077] Referring now additionally to FIGS. 3D and 3E, an exemplary embodiment is provided with a plurality of individual supporting members **300** extending from a defined vertical plane **301** supporting a chair embodiment (shown). Each individual supporting member includes a uniform separation distance S (shown as 30 mm preferably), and a respective length L (as noted). As will be understood from one skilled in the art following the above discussion regarding FIGS. 3B and 3C, the respective lengths pursue the respective curves Alpha and Beta as defined in Zones A and Zone B. Each respective length L begins with a spacing distance (25 mm) from the defined support plane **304** as a beginning base support. In this way a specific difference and spacing interval may be followed to pursue the above noted ratios, curve radii, and other specifics. As will be noted in this preferred embodiment, measurements for specific distances from a supporting floor or a seating level in the chair are provided to fully detail the locations relative to a desired user.

[0078] Referring now to FIGS. 4 through 7, another embodiment of a back support of a back support device **3** is provided including projected portion **3A** from the surface of a back support board extending vertically as **3C**. The extending line is one of waving or straight line, but in either case provides a linear plain of extension from the supporting floor and as shown in a W-type support, is adapted to this supporting extending surface in a pleasing manner.

[0079] As earlier discussed, and noted again here, in FIG. 5, it is obvious that projected portion **3C** extends from back surface **3A**. Further now in FIG. 6, the top view of the embodiment shows projection **3** from the back support surface **3A** and waving portion **3B** which is higher than the staring projection height in order to provide more ergonomic shape and comfortableness, as earlier discussed. Referring to FIG. 7, projection height of **3C** is in the range of 10 mm through 200 mm spaced from the defined vertical line. Preferably the projection height is in the range of 20 mm through 180 mm and further preferably in the range of 30 mm through 150 mm. The angle of the slope in FIG. 7 is in the range of 5° through 30°, preferably 10° through 25° and more preferably 12° through 20°.

[0080] In Table 1, the feelings and physical impressions are provided in a comparison chart between the present Embodiment 1 and a comparison conventional chair as in FIG. 1.

TABLE 1

Terms	Embodiment 1	Comparison conventional chair
Comfortableness	Very much comfortable	Comfortable
Back pressure from the support board	Very weak or almost no back pressure	Strong back pressure
Back	Naturally straight	Bending around the belly
Chest area	Open	Pressured from both side
Stomach area	Straight and open	Pressure and squeezed
Lower back	Natural straight	Rounded
Respiration	Easy and improved	Not improved
Movement	Almost no unintended movement around projected point of support	Need muscle use to prevent unwanted movement
Overall	Very natural and feeling as if standing straightly even seating. Improving blood stream of back due to opening chest and stomach, and to force pushing the back to the front.	Comfortable but need to pay attention and effort to keep comfortable pose

[0081] Referring now to FIG. 8, another embodiment of a portable back support system 400 is shown with a basic back support structure member 401 that may be readily applicable to a variety of uses and products. The portable back support system 400 may be fixed to a chair with an appropriated device such as a belt (not shown in Fig.) and/or incorporated into such as a car seat (shown later in FIG. 14) or back support back pack (shown in FIG. 18). Further portable back support is made of rigid, hard or substantially-rigid material like wood, resin, plastic, rigid foam and metal, but not limited, to avoid flattening the structure of the back support during a use.

[0082] Referring now to FIGS. 9, 10 and 11 showing a side view, a front view and a top view of another embodiment 450 in a chair 452, wherein the ridge line 451 of the project portion in the side view is extending from the lower back to the upper back. The size of the back support is shown in the front view is almost covering the entire back portion with a wave structure. The structural feature of the back support of the present

invention is further presented in the top view, noting the above-discussed arcs, curves, and construction. Specifically, the structure of the back support of the present invention is completely different from any conventional back support having a flat or a concave structure.

[0083] Referring now to FIGS. 13 and 14, a third embodiment of a car seat of a back support device is provided in response to a conventional seat in FIG. 12. A prior art of a car seat is shown in FIG. 12, in which the seat is compressible foam to restrict the body movement for safer driving or even race driving and to cushion or absorb the force of supporting such a body. In contrast to the conventional construction, in FIG. 13, an embodiment 470 of a seat provides a seat having projected center portion 472 in vertical direction on the surface of back support. While seating and driving, a driver may receive an 'opening' force and consequently less stress on the back and internal organs. It shall be recognized here that the support member depicted may be constructed from a single shaped support (monolithically formed) or from a plurality of articulated separate support shapes retained relative to the unit and allowing relative sliding or shifting and motion there between adjustable to a particular users need. It is easily predicted that many professional drivers including taxi driver and long-distance truck driver are complaining of stomach complications and fatigue because of very long driving may be relieved using Embodiment 3.

[0084] In FIG. 14, the explosive view of the embodiment is provided, wherein in the element of the back support of the present invention can be prefabricated in the car seat or be attached as a portable or removable device by a user. A prefabricated seat is not limited to the car seat, and can be a seat in an airplane, a theater, a school and any other type of seat where human will seat.

[0085] In Table 2, the driving test results are provided in a comparison chart between a conventional car seat and conventional car and airplane seats with a portable back support according to the construction of the present invention. The user who tested the back support of the present invention has been suffering from chronic lower back pain and difficulty to see front-upper portion ranges while driving due to spinal-curved visional problem occurring on the older person.

TABLE 2

Term	Embodiment 3	Comparison seats
When it is used for the first time	It provided unusual feeling but open sight and less pressure to the chest and stomach.	It provided calming feel but giving some pressure to the chest and stomach, unpleasantness to the lower back.
While a few hours driving	Lesser pain with minor pressure to the spine which is gone after a while.	Painful and hard to continue driving, and driving is no longer desirable.
After a few hours driving	Easily get out the car without pain and bending or stooping lumber	Hard to get out the car with stooping lumber and hard to see straight forward
While a longer flight than ten hours in a economy class	Comfortable and no pain	Even if a small pillow to the lumber or lower back, it is painful and unbearable time.
After a longer flight	Much less fatigue	Very tired and feeling unwanted time

[0086] Referring now to FIG. 15, an additional embodiment of a lumbar back support system 800 includes rigid projected portion 801 inside a retaining pocket 801A (shown held in place by a fabric layer with grommets), of a wide belt member 802. A releasable closure system 804 on either end of belt member 802, preferably a hook-and-loop closure system like Velcro® is employed to allow a user to employ the belt system 800 around their torso during use, either in their clothing or outside their clothing. In this way, the same support member discussed above may be adaptively employed in a back support system for improved user-convenience.

[0087] Referring now to FIGS. 16, 17, and 18, an additional embodiment of a back pack system 810 includes a back support system 811, of the present invention on the back with shoulder belts 812. In FIG. 18 is a exploded view of the embodiment notes back support system 810 comprising a front portion 813 including the shoulder belt 812, back support 811 and a flexible slide cover 814 such as a nylon pouch, and an outer rear portion 815 containing a variety of goods and books and so on and joinable with member 813 via a zipper system 816 as a combined unit or kit 810 which can be used also as an portable back support of the present invention by attaching to a chair or any other back support without the back support of the present invention. As will be understood rear portion 815 is a compartment. Both of portions 815 and 813 are combined to make an back pack system 810 which is more comfortable while carrying because of force-to-front effect of back support 7c.

[0088] Referring now to FIGS. 19 through 22, additional embodiments are depicted as chairs with back support device including a neck-rest means are provided. A neck-rest embodiment 900 of the embodiment is presented with a neck rest region 901 that will provide additional neck-spine support as shown. Embodiment 900 may improve user's conditions whose neck or around neck difficulties has complications such as cervical spine injury and whiplash injury. In FIG. 20, a person/user 903 who has a cervical injury is seating on an expensive conventional chair 904 and as will be noted a defined neck-spine axis 905 is not parallel to a body-spine axis 906, at a relative angle α . This off relative angle α results necessarily in poor neck support and pain. In contrast, see FIG. 21, the same person 903 is seating on a back support chair 907 with neck-rest portion 901 and a defined neck-spine axis 908 is parallel with a body-spine axis 909 allowing for comfortable support while employing the same Zone A and Zone B construction as earlier noted.

[0089] Referring additional to FIG. 22, as will be appreciated by one of skill in the art having read and understood the present disclosure, if a person sits on a conventional chair 910, in FIG. 22, the individual person's neck will not naturally position in a straight line (neck-spine axis 910) with the spinal axis 911 (the overall direction of the spine, and not required to be literally a straight line axis) because the head is heavy and easily falls toward frontwardly so that any neck-rest would not help the neck being straight necessarily creating a stress angle α , as noted above. In contrast, a person seating on the embodiment noted in FIG. 21 may keep easily the straight-up body posture, in which a neck-rest works unexpectedly because a chest and a throat are naturally in open an state thereby also improving breathing and minimizing snoring during sleeping. According to these results, the present invention may provide not only comfortable seating or lying pose but also may provide a neck-rest workable naturally.

[0090] Referring now to FIG. 23, another alternative embodiment of the present invention 920 includes back support system 921, a neck-support portion 922 having a height adjustable arm system 923, allowing a neck-rest member 924 to adjust relative to back support system 921. In this way, embodiment 920 may be individually optimized in accordance with user's length between hip and neck.

[0091] Referring now to FIG. 24 an additional embodiment includes a back support member 925 secured to a chair 926 and a movement stopping member 927. Movement stopping member 927 projects upwardly away from a seat support surface to interfere between a user's legs as a wedge. In this way, the movement stopping member 927 prevents the hip portion of a user from moving forward (away from support 925), and keeps a user's body-shape correctly without giving stress to the body.

[0092] The present invention may not be limited to the embodiments noted above and may be applied to a variety of back support or pose correction devices including a bed, a mattress, a floor mattress, a back support for lifting heavy materials, a corset for shaping up and/or correction of defected body without departing of the present invention's spirit.

[0093] Referring now to FIG. 25 an additional embodiment provides an adjustable system 980 for personalizing a back support system 981. As depicted, a plurality of individual moveable members 981 are formed in an undulating shaped manner according to the present invention, each respectively have substantially the same size and shape, but being independently movable according to a user need along both a support axis direction T and laterally from the support axis along a direction L, to provide contacting pressure on a user's spinal column (e.g., two dimensional adjustment motion). Respective pieces are movable back and forth to be adjusted to use's back shape. When the position is determined, each piece is fixed with a securing system 985, shown as a threaded screw member. Respective pieces are held by such rubber bands or other temporary means during a fitting process until a user is satisfied of matching their personalized back physiology. A vertical support member 986 extending from a back of the chair member 987 provides additional stability during the set-up process for each user. Following the set-up process, a fully constructed chair (like that shown in FIG. 3D) may be constructed from the now arranged measurements.

[0094] Referring now to FIG. 26, a pictorial representations of a plurality of support members 990 having the noted dimensions L1 (220 mm), L2 (80 mm), L3 (50 mm), L4 (60 mm) are provided and may be spaced along the upright support member 991 on a chair base 992, to construct a chair system about a centerline (CL), as noted. In each reference number the distances are measured in mm (millimeters) and as a consequence, incorporating the known detail from above, a full chair support system 995 may be constructed by adding a respective plurality of individual undulating support members 990.

[0095] As used herein, those of skill in the art having read and understood the above disclosure will recognize the use of the phrases rigid or fully-rigid or non-resilient or non-deflectable as being descriptions under normal or expected human body forces. For example, a 400 lb adult male user resting on a chair may exert approximately 60 lbs to 80 lbs of backward or back-support force along a vector perpendicular to the user's torso and directly into the support—under this type of force the back support is to be non-moving or non-deflectable

from an original shape and form as discussed and claimed herein. This type of use is in full contrast to any previously recognized support systems which attempt to employ a deflectable cushioned member to urge support—necessarily during use these previously recognized support systems deflect from their original supporting shape.

[0096] In the claims, means- or step-plus-function clauses are intended to cover the structures described or suggested herein as performing the recited function and not only structural equivalents but also equivalent structures. Thus, for example, although a nail, a screw, and a bolt may not be structural equivalents in that a nail relies on friction between a wooden part and a cylindrical surface, a screw's helical surface positively engages the wooden part, and a bolt's head and nut compress opposite sides of a wooden part, in the environment of fastening wooden parts, a nail, a screw, and a bolt may be readily understood by those skilled in the art as equivalent structures.

[0097] Having described at least one of the preferred embodiments of the present invention with reference to the accompanying drawings, it is to be understood that the invention is not limited to those precise embodiments, and that various changes, modifications, and adaptations may be effected therein by one skilled in the art without departing from the scope or spirit of the invention as defined in the appended claims.

1-15. (canceled)

16. A back support system, comprising
a rigid monolithic support member;

said rigid support member having a substantially planar back surface and defining a support base surface arranged substantially perpendicular thereto and a top surface also arranged substantially perpendicular thereto and spaced from said support base surface by a distance divided into a first zone A, and a second zone B; in an upright arrangement in an external gravity field with said support base surface at a bottom location, said rigid support member having a height greater than a width defined along opposing sides of said upright length;

a first continuous arc surface alpha defined distal from said substantially planar back surface and extending from support base surface to said top surface in a convex curve relative to said substantially planar back surface;

a second continuous arc surface beta defined extending from opposing sides of edges denoting said width defined along said upright length in a convex curve relative to said substantially planar back surface;

said alpha and beta arc surfaces interacting to form a continuously changing three-dimensional arc extending from said support base surface to said top surface and from opposing sides of said width defined along said upright length;

an apex plane surface defined as extending from said substantially planar back surface to said alpha and beta arc surfaces and defining a separation between said first zone A and said second zone B;

said apex plane surface defined at a location spaced from said base support surface by 20% of the distance to said top surface and having a maximum apex distance along a length of both alpha and beta arc surfaces;

an apex of said convex curve relative to said base support surface being a distance X that is less than said maximum apex distance of said apex plane, by a ratio that is X-1, wherein $X-1$ is $0.90 > X-1 > 0.85$; and

an apex of the convex of said convex curve about said top surface being a distance Y that is less than said maximum apex distance of said apex plane, by a ratio that is Y-1, wherein $Y-1$ is $0.60 > Y-1 > 0.50$, and whereby said rigid monolithic support structure provides a continuously curved rigid support to a back of an external user.

17. A back support system, according to claim 16, wherein: said ratio X-1 is preferably 0.87; and said ratio Y-1 is preferably 0.53.

18. A back support system, according to claim 16, wherein: said continuous curve beta is at least a compound curve containing the sum of two radii defined at any reference position along said substantially planar back surface and extending perpendicularly therefrom, from said support base surface through said apex plane surface to said top surface;

a line extending tangentially to each said curve formed by said radii and joining thereto forming said continuous curve beta along any said reference position;

the ratio R-base of a minimum radii to a maximum radii of each respective defined curve at said support base surface being $0.65 > R\text{-apex} > 0.60$, and preferably 0.63;

the ratio R-apex of a minimum radii to a maximum radii of each respective defined curve at said apex plane surface being $0.75 > R\text{-apex} > 0.70$, and preferably 0.73; and

the ratio R-top of a minimum radii to a maximum radii of each respective defined curve at said top surface being $0.25 > R\text{-top} > 0.15$, and preferably 0.19.

19. A back support system, according to claim 18, wherein: said ratio X-1 is preferably 0.87; and said ratio Y-1 is preferably 0.53.

20. A back support system, according to claim 18, wherein: the ratio R-base is preferably about 0.63;

the ratio R-apex is preferably about 0.73; and

the ratio R-top is preferably about 0.19, wherein said back support system enables a reduction in the compressive force exerted on a back of said external user employing said back support system.

21. A back support system, according to claim 18, further comprising:

an additional zone portion identified as a third zone C and extending from said defined top surface along said substantially planar back surface to a defined additional third top surface;

said additional zone portion containing a third continuous arc surface alpha-1 defined distal from said substantially planar back surface and extending from defined top surface to said third top surface in a convex curve relative to said substantially planar back surface;

an arc of said continuous arc surface alpha-1 being different than said arc of said continuous arc alpha;

a fourth continuous arc surface beta-1 defined extending from opposing sides of edges denoting said width defined along said upright length in a convex curve relative to said substantially planar back surface between said defined top surface and said third top surface;

an arc of said continuous arc surface beta-1 being different than said arc of said continuous arc beta;

said alpha-1 and said beta-1 arc surfaces interacting to form a continuously changing three-dimensional arc extending from said top surface to said additional third top surface and from opposing sides of said width defined along said upright length;

said third top surface extending from said substantially planar back surface to said alpha-1 and said beta-1 arc surfaces and defining an apex of said third top surface curve;

said third top surface defined at a location spaced from said top surface a distance that is 80% of the distance between said support base surface and said top surface, whereby said third zone C substantially extends the upright dimension of said back support member; and an apex of said convex curve relative to said third top surface being a distance Z that is less than said maximum apex distance of said apex plane, by a ratio that is Z-1, wherein $Z-1$ is $0.40 > Z-1 > 0.30$.

22. A back support system, according to claim 18, wherein: said ratio Z-1 is preferably about 0.35.

23. A back support system, according to claim 19, further comprising:

an retaining member containing a holding region;
said back support member releasably retained in said holding region;
an adjustable securing means for enabling a securement of said elastic retaining member containing said back support member to a desired location during a use.

24. A back support system, according to claim 23, wherein: said desired location is one of a user back support wrap, a back-pack, and a chair support member.

25. A back support system, according to claim 23, wherein: said retaining member includes an elastomeric region; said elastomeric region enables a use of said back support member as a user-back support wrap; wherein during said use of said retaining member as said support wrap, a compressive urging force is exerted inwardly on said user from said rigid monolithic support member.

26. A back support system, according to claim 23, wherein: said retaining member is a back-pack;
said adjustable securing means including a pair of user-shoulder straps extending from said back-pack enabling use by an external user; and
said adjustable securing means additionally including a partitioning means for internally retaining said support member bounded by said back-pack and adjustably securing said support member therein.

27. A back support system, according to claim 23, wherein: said retaining member is a strap system for securing said support member relative to one of an external chair and an external seat, thereby enabling use of said back support system as a back-support during a user-sitting-activity.

28. A back support system, comprising:
a plurality of undulating support members;
each said individual undulating support member including a back reference plane and an undulating surface extending relative thereto from a first side to a second side;
a midpoint region to each said undulating support member being spaced from said back reference plane a distance greater than non-midpoint regions between said first and said second side;

means for vertically positioning said plurality of undulating support members relative to each other along a vertical reference direction; and

means for individually securing each said undulating support member in a position independently from respective other undulating support members; whereby said back support system allows individualized positioning and securing of respective said undulating support members along both a first lateral direction away from said vertical reference direction and a second vertical direction thereby allowing improved positioning of a plurality of undulating support members.

29. A chair, comprising:

a back support system, further comprising:

a plurality of undulating support members;

each said individual undulating support member including a back reference plane and an undulating surface extending relative thereto from a first side to a second side;

a midpoint region to each said undulating support member being spaced from said back reference plane a distance greater than non-midpoint regions between said first and said second side;

means for vertically positioning said plurality of undulating support members relative to each other along a vertical reference direction; and

means for individually securing each said undulating support member in a position independently from respective other undulating support members; whereby said back support system allows individualized positioning and securing of respective said undulating support members along both a first lateral direction away from said vertical reference direction and a second vertical direction thereby allowing improved positioning of a plurality of undulating support members.

30. A method for arranging a back support system relative to a back of a user, comprising the steps of:

providing a first support structure having a user support member and an upright reference direction member;

providing a plurality of undulating support members;

each said individual undulating support member including a back reference plane and an undulating surface extending relative thereto from a first side to a second side;

a midpoint region to each said undulating support member being spaced from said back reference plane a distance greater than non-midpoint regions between said first and said second side;

providing means for vertically positioning said plurality of undulating support members relative to each other along a vertical reference direction; and

providing means for individually urging and securing each said undulating support member in a position independently from respective other undulating support members; whereby said back support system allows individualized positioning and securing of respective said undulating support members along both a first lateral direction away from said vertical reference direction and a second vertical direction thereby allowing improved positioning of a plurality of undulating support members.

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