CHAIR WITH LUMBAR SUPPORT AND CONFORMING BACK

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Abstract

A task chair including a seat support structure, a backrest frame attached to the seat support structure, and a backrest supported by the backrest frame. The backrest includes a back support surface which may ergonomically conform to a seated user when the user shifts positions while sitting in the chair. The back support surface includes rigid and flexible portions connected to one another, the flexible portions allowing resilient flexing of the back support surface to create conformance zones which dynamically support the back of a seated user in an ergonomic manner.
CHAIR WITH LUMBAR SUPPORT AND CONFORMING BACK

CROSS REFERENCE TO RELATED APPLICATIONS


BACKGROUND OF THE INVENTION


[0003] The present invention relates to chairs, and in particular, to a task chair for supporting the back of a seated user in an ergonomic manner.

[0004] 2. Description of the Related Art.

[0005] Task chairs are commonly used by persons while working in a seated position in offices or other occupational environments. Typically, such chairs include a caster wheel assembly supporting the chair for rolling movement over a floor surface, as well as a number of manual adjustment features to allow the user to adjust the shape or movement characteristics of the chair to a desired configuration.

[0006] Many task chairs include a rigid back pan having a layer of foam padding thereon which is covered by a decorative upholstery material, and may also include an adjustable lumbar support mechanism built into the backrest. Such backrests typically allow only a very limited degree of adjustment, in terms of both the movement of the lumbar support and the reclining of the backrest. Further, adjustment of the backrest is typically performed by manual operation of controls which may be difficult to locate and manipulate.

[0007] What is needed is a task chair having a backrest which conformingly and comfortably supports a seated user, and which is an improvement over the foregoing.

SUMMARY OF THE INVENTION

[0008] The present invention provides a task chair including a seat support structure, a backrest frame attached to the seat support structure, and a backrest supported by the backrest frame. The backrest includes a back support surface which ergonomically conforms to a seated user when the seated user shifts positions while sitting in the chair. The back support surface includes rigid and flexible portions connected to one another, the flexible portions allowing resilient flexing of the back support surface to create conformance zones which dynamically support the back of a seated user in an ergonomic manner.

[0009] The rigid portions of the backrest may be formed of wood, metal, or a rigid plastic, and the flexible portions may be formed of a pliable urethane or a silicone material, for example. The rigid and flexible portions are connected to one another by insert molding the flexible portions to the rigid portions, or by mechanically or adhesively joining the flexible portions to the rigid portions. The particular shape, size, and relative configurations of the rigid portions and the flexible portions may be selectively varied to provide a backrest surface having desired conformance and support characteristics for supporting the back of a seated user in the chair.

[0010] The backrest is connected to the seat support structure by a backrest frame, which may include one or more support arms which may be moveably mounted to the seat support structure. The support arms additionally include support portions extending therefrom which are in abutment with the rigid portions of the backrest to define substantially rigid flex points about which the back support surface may flex to conform to the back of a seated user. In addition, the backrest may be connected to the backrest frame at one or more flex joints which facilitate flexing of the lumbar portion of the backrest outwardly or forwardly to support the lumbar area of the back of a seated user when the user leans backwardly against an upper portion of the backrest. The flex joints may flex together or may flex independently from one another, and additionally, the flex joints may flex to a varying extent with respect to one another.

[0011] A slide plate may connect the backrest frame to a rigid portion of the backrest. The slide plate is slideable with respect to the backrest frame to adjust the height position of the backrest with respect to the backrest frame.

[0012] Additionally, the flexible portion of the backrest may include a lumbar support portion which bows outwardly from the backrest to define a flexible lumbar support. The backrest frame may additionally include a pair of slide plates slidably attached thereon, the slide plates slideable with respect to the backrest frame in response to forces exerted on the lumbar support portion of the backrest. A force mechanism may be operably associated with the slide plates to bias same to a position in which the lumbar support portion of the backrest is forced to bow outwardly, thus providing a firm, yet flexible, support to the lumbar region of a seated user.

[0013] Advantageously, the present task chair in one form thereof includes a back support surface having rigid portions which may be configured to provide a relatively firm support to the lumbar region or another region of the back of a seated user, and flexible portions which facilitate resilient flexing movement of the backrest and which provide a relatively cushioning support to certain areas of the back of a seated user in selected zones of the back support surface. The upper portion of the backrest and the lumbar portion of the backrest may flex about flex points provided by the backrest frame to dynamically conform to the upper and lumbar regions of the back of a seated user as the seated user shifts positions while sitting in the chair.

[0014] In one form thereof, the present invention provides a chair, including seat support structure; a backrest frame connected to the seat support structure; and a backrest formed of a flexible portion having at least one rigid member embedded therein, the backrest frame connected to the at least one rigid member at least one flex point, the backrest resiliently movable about the at least one flex point to conform to a seated user.

[0015] In another form thereof, the present invention provides a chair, including seat support structure; a backrest frame connected to the seat support structure; and a backrest including a flexible body portion surrounding at least two rigid portions, the at least two rigid portions pivotally attached to the backrest frame at respective joints which are disposed proximate opposite sides of the backrest.
BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The above-mentioned and other features and advantages of this invention, and the manner of attaining them, will become more apparent and the invention itself will be better understood by reference to the following description of embodiments of the invention taken in conjunction with the accompanying drawings, wherein:

[0017] FIG. 1 is a side elevational view of a task chair in accordance with the present invention;

[0018] FIG. 2 is an additional side elevational view of the task chair of FIG. 1, schematically showing a user seated therein;

[0019] FIG. 3 is a rear elevational view of the task chair of FIG. 1;

[0020] FIG. 4 is a rear perspective view of one embodiment of a backrest in accordance with the present invention, including a backrest frame having a pair of support arms moveably connected to the seat support structure of a chair, and supporting a backrest which includes rigid and flexible portions defining a back support surface which is flexible between a first position shown in solid lines and a second position shown in dashed lines;

[0021] FIG. 5 is a rear perspective view of a second embodiment of a backrest in accordance with the present invention, including a backrest frame having a supporting arm moveably connected to the seat support structure of a chair, and supporting a backrest including rigid and flexible portions defining a back support surface which is flexible between a first position shown in solid lines and a second position shown in dashed lines;

[0022] FIG. 6A is a rear perspective view of a third embodiment of a backrest in accordance with the present invention, including a backrest frame having a supporting arm supporting a backrest at a pair of flex joints positioned proximate sides of the backrest, the backrest flexing at both flex joints between a first position shown in solid lines and a second position shown in dashed lines;

[0023] FIG. 6B is a side elevational view of the embodiment of FIG. 6A;

[0024] FIG. 6C is a side second elevational view of the embodiment of FIG. 6A, showing the backrest flexing about the flex joints;

[0025] FIG. 6D is a second rear perspective view of the embodiment of FIG. 6A, the backrest flexing at one flex joint between a first position shown in solid lines and a second position shown in dashed lines;

[0026] FIG. 6E is an enlarged fragmentary view of a portion of FIG. 6C;

[0027] FIG. 7 is a rear perspective view of a fourth embodiment of a backrest in accordance with the present invention, including a backrest frame moveably connected to the seat support structure of a chair, and a slide plate secured to a rigid portion of the backrest, and slidably connected to the backrest frame for adjustment of the height position of the backrest with respect to the backrest frame; and

[0028] FIG. 8 is a rear perspective view of a fifth embodiment of a backrest in accordance with the present invention, including a backrest frame moveably connected to the seat support structure of a chair, and a pair of slide plates secured to respective rigid portions of the chair, the slide plates slidable within the backrest frame in response to forces exerted on a flexible lumbar support portion of the backrest which bows outwardly from the backrest.

[0029] Corresponding reference characters indicate corresponding parts throughout the several views. The exemplifications set out herein illustrate preferred embodiments of the invention, and such exemplifications are not to be construed as limiting the scope of the invention in any manner.

DETAILED DESCRIPTION

[0030] Task chair 20 is shown in FIGS. 1-3, and generally includes seat portion 22, backrest portion 24, and seat support structure 26. Seat support structure 26 includes caster wheel assembly 32 having a plurality of arms 34 projecting radially outwardly of central hub 36, the terminal ends of arms 34 having caster wheels 38 pivotally mounted thereon. Supported within central hub 36 of caster wheel assembly 32 is a height-adjustable pneumatic cylinder 40. Cylinder 40 includes piston 42 slidably disposed therein, an upper end of which is attached to chair support beam 44 by a press fit or in another suitable manner.

[0031] A plurality of links 46 (only two of which are shown in FIGS. 1 and 2 for clarity) each include first ends 48 pivotally attached to chair support beam 44 and second ends 50 pivotally attached to seat support member 52. Referring to FIG. 3, seat support member 52 is connected to U-shaped arm support 54 having upper ends 56 to which a pair of adjustable or fixed armrests 58 are connected. Armrests 58 may include moveable armrest pads 60, which may be adjusted as desired by a user. Also attached to upper ends 56 of U-shaped arm support 54 are a pair of L-shaped brackets 62 including lower ends 64 supporting chair seat 70, and upper ends 66 pivotally attached to U-shaped arm support 54. Backrest frame 68 extends between and is moveably mounted to upper ends 66 of the two L-shaped brackets 62 and arm support 54. Backrest frame 68 is connected to and supports backrest 72 as described below.

[0032] Chair support structure 26 and chair seat 70 may be of the type described in U.S. Provisional Patent Application Serial No. 60/340,570, entitled CHAIR WITH CONFORMING SEAT, filed on Dec. 14, 2001, assigned to the assignee of the present invention, the disclosure of which is expressly incorporated herein by reference.

[0033] Referring to FIG. 4, a first embodiment of backrest 72 is shown. Backrest 72a includes backrest frame 68 having a pair of support arms 82 with first ends 84 moveably connected to upper ends 66 of L-shaped brackets 62. Support arms 82 each include second ends 86 opposite first ends 84 which include support portions 88 projecting upwardly therefrom. Support portions 88 of support arms 82 are attached to rigid portion 80a of backrest 72a in a suitable manner, with rubber bushings 92 therebetween. Support portions 88 of lumbar support arms 82 and rubber bushings 92 provide substantially rigid flex points which, in cooperation with the flexible portions of backrest 72, allow backrest 72 to ergonomically conform to a seated user, as described in further detail below.
Backrest 72a includes back support surface 94a defined by rigid portion 80a and flexible portion 90a. Rigid portion 80a has a generally inverted T-shape, including base section 96a and a single arm section 98a projecting upwardly therefrom and disposed centrally within backrest 72a. Flexible portion 90a is disposed around the periphery of rigid portion 80a and on either side of arm section 98a thereof.

Suitable materials for the rigid portions of the backrests disclosed herein include, for example, a 9-ply, gumwood, upholstery grade plywood or a rotary cut maple veneer shell. Alternatively, the rigid portions may be made from metal or a suitable rigid or semi-rigid plastic material. The flexible portions of the backrests may be made from an elastomeric material, such as a urethane or a silicone material, for example. Such material may have one or more of a shore hardness ranging from 37±7A to 82±7A, a tensile strength ranging from 505 PSI to 2200 PSI as determined by ASTM D-412, and an elongation of 320% to 340% as determined by ASTM D-368. Suitable urethane materials for the flexible portion include Vantico brand polyurethanes, available from Ciba Specialty Chemicals, such as RP6400-1, RP6401-1, RP 6402-1, and RP 6410-1 polyurethanes. The thickness of the flexible portion may be uniform throughout the backrest, or alternatively, the thickness of the flexible portion may be varied as desired. The flexibility of the flexible portion generally decreases with increasing material thickness. Conversely, the flexibility of the flexible portion generally increases with decreasing material thickness.

In each of the embodiments of the backrests disclosed herein, the flexible portion of the backrest is resiliently flexible, such that the flexible portion may flex or bend to change shape in response to a force or load exerted thereon, followed by return of the flexible portion to its original shape or position when the force or load is removed. The material of the flexible portion may also exhibit elasticity, wherein the material may stretch as necessary responsive to forces exerted thereon, followed by return to its original shape and position. Further, the flexible portion may optionally include a series of perforations, a series of ridges and valleys, scoring, or other features therein which facilitate flexing movement in designated areas of the flexible portion.

The flexible portion of the backrest may be attached to one or more rigid portions thereof by insert molding, wherein the rigid portion is placed in a mold, and the flexible portion is molded therearound such that, upon curing, the flexible portion surrounds the periphery of the rigid portion and is securely adhered to the rigid portion. For example, if the rigid portion is made of wood or another porous or semi-porous material having roughened surfaces, the flexible portion may penetrate within the interstices of the rigid portion and, upon curing, form a tight bond with same.

Another molding process which may be used to form the backrest is performed according to a two-step molding procedure, sometimes referred to in the art as a “two-shot” molding process. First, the rigid portions are formed from a first plastic material which is substantially rigid upon curing. The first material is injected into one or more molds which correspond to the shape of the rigid portions of the backrest. Then, before the material of the rigid portions is fully cured, the flexible material is injected around the rigid portions into a mold which corresponds to the shape of the backrest. The flexible material forms a chemical bond with the partially cured rigid material to provide a very strong connection between the rigid and flexible portions of the chair. After the flexible and rigid materials cure, the mold is removed to provide the backrest.

The rigid portion is at least partially embedded within the flexible portion such that the flexible portion surrounds the outer periphery of the rigid portion. The top and bottom surfaces of the rigid portion may be exposed, or alternatively, the rigid portion may be completely embedded or encapsulated within the flexible portion such that the flexible portion encompasses all sides of the rigid portion. Alternatively, the flexible portion may be pre-molded, wherein after curing thereof, the flexible portion is mechanically or adhesively joined to the rigid portion by a suitable adhesive or by suitable fasteners, for example.

As discussed below, the shapes and relative configurations of the rigid and flexible portions of the backrests of the present invention may be varied substantially in order to selectively modify the nature of the support provided by the rigid portions and the flexible portions, as well as the dynamics of the flexing of the back support surfaces of the backrests. The embodiments of FIGS. 4-8 illustrate some possible shapes and relative configurations of the rigid and flexible portions, although one of ordinary skill in the art may develop others based upon the teachings herein.

Referring again to FIG. 4, it may be seen that backrest 72a is supported by support arms 82 of backrest frame 68, which are movably connected to seat support structure 26 of chair 20 by joint mechanism 100. Joint mechanism 100 includes an energy source (not shown), such as a torsion spring or other torsion element such as a stiff rubber bushing, which allows the positioning of support arms 82 and backrest 72a to be varied in response to the weight of a user seated in chair 20. For example, support arms 82 and backrest 72a are shown in a first, more upright position in solid lines in FIG. 4, and in a second, more reclined position in dashed lines in FIG. 4. Joint mechanism 100 may include a tension adjustment member, such as lever 102, for example, for varying the pre-tension of the energy source of joint mechanism 100 to provide selectively more or less resistance to movement of support arms 82.

When a user is seated in chair 20, the upper back and shoulder blades of the user abut the upper sections of flexible portion 90a which are disposed in either side of arm section 98a of rigid portion 80a. As a seated user shifts positions while seated in chair 20, for example by leaning backward and to one side, or by twisting about the user's trunk, the upper sections of flexible portion 90a may flex about arm section 98a of rigid portion 80a, and rigid portion 80a may flex about arm section 98a of rigid portion 80a, and rigid portion 80a may flex about substantially rigid fulcrum points which are defined by the attachment of support portions 88 of support arms 82 to rigid portion 80a of backrest 72a by rubber bushings 92. In other words, such flex points provide substantially rigid fulcrum points about which back support surface 94a of backrest 72a may flex. Further, as described in more detail below with respect to the embodiment of FIGS. 6A-D, the flex points which are defined by the attachment of support portions 88 of support arms 82 to rigid portion 80a of backrest 72a by rubber bushings 92 may
further include flex joints which facilitate forward or outward flexing of the lumbar portion of backrest 72a when a user leans backward against the upper portion of backrest 72a.

[0043] A second embodiment of backrest 72, backrest 72b, is shown in FIG. 5, and is somewhat similar to backrest 72a. Backrest 72b includes back support surface 94b defined by rigid portion 80b and flexible portion 90b. Rigid portion 80b is generally U-shaped, including base section 96b and a pair of arm sections 98b projecting upwardly therefrom. Flexible portion 90b is disposed around the periphery of rigid portion 80b and in between rigid portions 90b. Backrest 72b is supported by backrest frame 68 including a single support arm 106, having first ends 108 movably attached to upper ends 66 of L-shaped brackets 62. Joint mechanism 100 operates similar to the joint mechanism 100 described above with respect to backrest 72a. Joint mechanism 100 of backrest 72b may also include tension adjustment lever 102, which is provided for adjusting the pre-tension of the energy source of joint mechanism 100, which supports support arm 106 and backrest 72b and allows movement of same between the more upright position shown in solid lines and the more reclined position shown in dashed lines in FIG. 5 in response to weight of a seated user. Support arm 106 also includes support portions 110 secured to arm sections 98b of rigid portion 80b, with rubber bushings 92 disposed therebetween.

[0044] When a user is seated in chair 20 having backrest 72b, the upper back and shoulder blades of the user abut arm sections 98b of rigid portion 80b, and the spine of the seated user is cushioned by the area of flexible portion 90b which is disposed between arm sections 98b of rigid portion 80b. As a seated user shifts positions while seated in chair 20, for example by leaning backward and to one side, or by twisting about the user’s trunk, rigid portions 90b may flex about flexible portion 90b disposed therebetween, and about the pair of substantially rigid flex points which are defined by the attachment of support portions 110 of support arm 106 to rigid portion 80b by rubber bushings 92. In other words, such flex points provide substantially rigid fulcrum points about which the back support surface 94b of backrest 72b may flex. Further, as described in more detail below with respect to the embodiment of FIGS. 6A-D, the flex points which are defined by the attachment of support portions 110 of support arm 106 to rigid portion 80b of backrest 72b by rubber bushings 92 may each further include a flex joint which facilitates forward or outward flexing of the lumbar portion of backrest 72b when a user leans backward against the upper portion of backrest 72b.

[0045] A third embodiment of backrest 72 is shown in FIGS. 6A-6D. Backrest 72c includes back support surface 94c defined by a pair of rigid portions 80c which are disposed along respective sides of backrest 72c, and flexible portion 90c which is disposed around the peripheries of rigid portions 80c and which defines the remainder of backrest 72c. Backrest 72c is supported by backrest frame 150 having central portion 152 and end portions 154 attached to the upper ends 56 of U-shaped arm support 54. Support arm 156 includes central portion 158 attached to central portion 152 of backrest frame 150, and also includes end portions 160 attached to rigid portions 80c of backrest 72c at flex joints 162, as described below. The attachment of central portion 158 of support arm 156 to central portion 152 of backrest frame 150 may be a fixed connection, or alternatively, may be an adjustable connection which provides vertical height adjustment of support arm 156 and backrest 72c with respect to backrest frame 150.

[0046] Rigid portions 80c may optionally further include spring members 155, which are made from a suitable semi-rigid, yet resilient material such as spring steel or a semi-rigid plastic. Spring members 155 are shown in FIGS. 6A and 6D extending upwardly from rigid portions 80c. Spring members 155 may comprise separate components attached to rigid portions 80c, or alternatively, spring members 155 may be integrally formed with rigid portions 80c as extensions of rigid portions 80c. Spring members 155 are shown encapsulated within flexible portion 90c, but may alternatively be disposed in line or flush with the front or rear outer surfaces of flexible portion 90c of backrest 72c. Spring members 155 are generally more flexible than rigid portions 80c, yet are more stiff than flexible portion 90c, and may be selectively located in areas of backrest 72c in which additional support to flexible portion 90c is desired without the more rigid support which would otherwise be provided by rigid portions 80c. In the embodiment of FIGS. 6A-6D, spring members 155 provide resilient support within flexible portion 90c in the area of upper portion 172 of backrest 72c to support the area around the upper back of a seated user.

[0047] Flex joints 162 are generally configured to allow flexible, elastic movement of backrest 72c with respect to support arm 156 in response to movement of a seated user, and are shown in further detail in FIGS. 6B, 6C, and 6E. Flex joints 162 each include plate 164 attached to rigid portion 80c of backrest 72c, or alternatively, plates 164 may be integrally formed as a feature of rigid portions 80c. A rubber bushing 92 is disposed between each plate 164 and a corresponding end portion 160 of support arm 156. Pivot members 166, which may comprise axles or bolts, for example, are disposed through cooperating apertures in plates 164, rubber bushings 92, and end portions 160 of support arm 156 to pivotally attach backrest 72c to each end portion 160 of support arm 156 with rubber bushings 92 therebetween. Further, pivot members 166 define substantially horizontal pivot axes about which backrest 72c may pivot with respect to support arm 156. Although flex joints 162 are shown as pivots including pivot members 166, the particular construction of flex joints 162 may vary. For example, flex joints 162 may optionally be formed as ball-and-socket joints or as hinge joints. Also, flex joints 162 may rely solely on the resilient flexing properties of rubber bushings 92, which may be attached with adhesive or via suitable fasteners directly to each of rigid portions 80c and end portions 160 of support arm 156. Flex joints 162 may include metal springs, such as leaf springs, or coil springs disposed about pivot members 166, for example, instead of rubber bushings 92.

[0048] As shown in FIG. 6B, backrest 72c is disposed in an unflexed or neutral position for supporting the back of a user seated in chair 20. Backrest 72c includes lumbar portion 170, which is curved outwardly or forwardly from backrest 72c in the area of the lumbar region of the back of a seated user to thereby support the lumbar region of the seated user’s back. Vertical plane P1-P2 defines the outwardmost or forwardmost extent of lumbar portion 170 of backrest 72c in
the position shown in FIG. 6B. Upper portion 172 of backrest 72c is disposed in a first, substantially upright position in FIG. 6B.

[0049] As shown in FIGS. 6C and 6E, when a seated user leans backwardly against upper portion 172 of backrest 72c along the direction of arrow 174, backrest 72c pivots about member 166 of flex joint 162. Movement of backrest 72c as shown in FIGS. 6C and 6E, causes the upper portion of plates 164 of flex joints 162 to press against and compress the upper portions 92a of rubber bushings 92, while the lower portions 92b of rubber bushings 92 are allowed to expand as necessary. In this manner, the rubber bushings 92 provide a compressive force against pivoting of backrest 72c from the position shown in FIG. 6B. Notably, this compressive force also operates to return backrest 72c to the position shown in FIG. 6B when the seated user leans forwardly from upper portion 172 of backrest 72c in a direction opposite arrow 174. Further, movement of backrest 72c about member 166 of flex joint 162 as shown in FIG. 6C causes lumbar portion 170 to concurrently move outwardly or forwardly from vertical plane P1-P2 toward vertical plane P3-P4 along the direction of arrow 176 to increase the support provided by lumbar portion 170 to the lumbar region of the back of a seated user. Typically, lumbar portion 170 may move through a horizontal distance of up to two inches (5.08 cm) between planes P1-P2 and P3-P4.

[0050] As shown in FIGS. 6A and 6D, backrest 72c may pivot to the same extent at both flex joints 162, or flex joints 162 may pivot independently of one another, depending on the position of a user seated in chair 20. Further, the relative extent to which each flex joint 162 pivots with respect to the other flex joint may also vary, depending upon the position of a user seated in chair 20 and the relative distribution of the user’s weight against various areas of backrest 72c. Referring to FIG. 6A, when a seated user leans backwardly and evenly against upper portion 172 of backrest 72c along the direction of arrow 174, such as when a seated user presses both shoulder blades against upper portion 172 of backrest 72c, backrest 72c pivots to a similar extent at both flex joints 162a and 162b which are disposed at the left and right sides of backrest 72c, respectively. As described above, upper portion 172 of backrest 72c reclines from a substantially upright position, shown in solid lines in FIG. 6A, to a reclined position, shown in dashed lines in FIG. 6A. Concurrently, lumbar portion 170 flexes from a first position, shown in solid lines in FIG. 6A, to a more outwardly or forwardly projecting position, shown in dashed lines in FIG. 6A, to support the lumbar region of the back of the seated user along substantially the entire width of backrest 72c.

[0051] Referring to FIG. 6D, when a seated user leans backwardly and to one side of upper portion 172 of backrest 72c along arrow 178, such as when a seated user turns about the user’s trunk and presses only one shoulder blade against the left side of upper portion 172 of backrest 72c, backrest 72c pivots primarily at flex joint 162a and pivots only minimally, or not at all, at flex joint 162b. The left side of upper portion 172 of backrest 72c reclines from a substantially upright position, shown in solid lines in FIG. 6D, to a reclined position, shown in dashed lines in FIG. 6D. Concurrently, the left side of lumbar portion 170 flexes from a first position, shown in solid lines in FIG. 6D, to a more outwardly or forwardly projecting position, shown in dashed lines in FIG. 6D, to support the left area of the lumbar region of the seated user’s back. Of course, when a seated user leans backwardly to the opposite side of upper portion 172 of backrest 72c, such as when a seated user turns about the user’s trunk and presses only one shoulder blade against the right side of upper portion 172 of backrest 72c, backrest 72c pivots primarily at flex joint 162b, and pivots only minimally, or not at all, at flex joint 162a. In this manner, flex joints 162a and 162b may pivot concurrently or independently of one another as needed to accommodate and support the movement of a user seated in chair 20.

[0052] Referring to FIG. 7, a fourth embodiment of backrest 72 is shown. Backrest 72d includes back support surface 94d defined by rigid portion 80d and flexible portion 90d disposed around the periphery of rigid portion 80d. Backrest 72d is supported by backrest frame 112, having first ends 114a attached to upper ends 66 of L-shaped brackets 62. Backrest frame 112 includes central portion 116 with slide plate 118 slidable connected thereto. Slide plate 118 is secured to rigid portion 80d of backrest 72d, with rubber bushings 92 therebetween. The connection points between slide plate 118 and rigid portion 80d of backrest 72d provide substantially rigid flex points about which rigid portion 80d of backrest 72d may flex, similar to the manner described above with respect to backrests 72a-72c. Thus, as a seated user shifts positions while seated in chair 20, for example by leaning backward and to one side, or by twisting about the user’s trunk, rigid portion 80d may flex about such flex points, and flexible portion 90d may also flex with respect to both rigid portion 80d and such flex points.

[0053] Additionally, slide plate 118 may slide upwardly and downwardly with respect to central portion 116 of backrest frame 112, as indicated by arrow 113 in FIG. 7, to adjust the height position of backrest 72d with respect to backrest frame 112. The position of slide plate 118 with respect to central portion 116 of backrest frame 112 may be fixed in a selected position by a friction fit, or by a suitable locking or detent mechanism, for example.

[0054] A fourth embodiment of backrest 72 is shown in FIG. 8. Backrest 72e includes back support surface 94e defined by upper rigid portion 80e, lower rigid portion 80e′, and flexible portion 90e. Upper rigid portion 80e is generally U-shaped, including base section 96e and a pair of arm sections 98e projecting upwardly therefrom. Lower rigid portion 80e′ has a generally elongated oval shape. Flexible portion 90e is disposed around the peripheries of upper and lower rigid portions 80e and 80e′ and therewith, and also in between arm section 98e of upper rigid portion 80e. Additionally, flexible portion 90e includes a lumbar support portion 130 intermediate upper rigid portion 80e and lower rigid portion 80e′.

[0055] Backrest 72e is supported by backrest frame 122, having ends 123 moveably attached to upper ends 66 of L-shaped brackets 62. An adjustment mechanism, similar to those shown above with respect to backrests 72a, and 72b, may be provided for tension adjustment of backrest frame 122 with respect to the seat support structure of the chair. Backrest frame 122 includes central portion 124 with upper slide plate 126 and lower slide plate 128 slidably connected thereto. Upper and lower slide plates 126, 128 are secured to upper and lower rigid portions 80e and 80e′ of backrest 72e, respectively, with rubber bushings 92 therebetween. The connection points between upper slide plate 126 and rigid
portion 80c of backrest 72e provide substantially rigid flex points about which chair support surface 94e of backrest 72e may flex, similar to the manner described above with respect to backrests 72a-72d.

[0056] A force mechanism (not shown), such as a spring disposed within central portion 124 of backrest frame 122, biases each of upper and lower slide plates 126, 128 inwardly toward backrest frame 122. This spring mechanism, as well as the inherent flex tension in lumbar support portion 130, cause lumbar support portion 130 to bow outwardly from back support surface 94e in the area of the lumbar region of a seated user to define a flexible lumbar support, as shown in dashed lines in FIG. 8. Forces exerted upon lumbar support portion 130 from the abutment of a user’s back thereagainst move lumbar support portion 130 and slide plates 126, 128 to the positions shown in solid lines in FIG. 8, and such forces are resisted by the flex tension of lumbar support portion 130, and by the force mechanism within central portion 124 of backrest frame 122 which biases upper and lower slide plates 126, 128 inwardly, to provide a firm lumbar support to the seated user. When the user exits the chair, or leans forwardly away from backrest 72d, the flex tension of lumbar support portion 130 and the spring mechanism within central portion 124 of backrest frame 122 return lumbar support portion 130 to its more prominent forward position, shown in dashed lines in FIG. 8. The foregoing movement of lumbar support portion 130 and slide plates 126, 128 is illustrated by arrows 127 in FIG. 8.

[0057] While this invention has been described as having preferred designs, the present invention can be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the invention using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains and which fall within the limits of the appended claims.

What is claimed is:

1. A chair, comprising:
   - seat support structure;
   - a backrest frame connected to said seat support structure;
   - a backrest formed of a flexible portion having at least one rigid member embedded therein, said backrest frame connected to said at least one rigid member at least one flex point, said backrest resiliently movable about said at least one flex point to conform to a seated user.

2. The chair of claim 1, wherein said flexible portion is formed from one of a flexible urethane material and a flexible silicone material.

3. The chair of claim 1, wherein said at least one rigid member is made from one of wood, metal, and a plastic material.

4. The chair of claim 1, wherein said backrest includes at least two of said rigid members respectively disposed along opposite sides of said backrest, said backrest frame having opposite ends respectively connected to said rigid members at said flex points.

5. The chair of claim 1, wherein each said rigid member includes a spring member extending therefrom, said spring member embedded within said flexible portion.

6. The chair of claim 1, wherein each said flex point includes a flexible bushing member disposed between said backrest frame and said backrest rigid member, said bushing member providing a return force against movement of said backrest at said flex points.

7. The chair of claim 1, wherein said backrest includes a flexible upper portion, said upper portion resiliently moveable about said flex points between a substantially upright position and a reclined position responsive to movement of a seated user.

8. The chair of claim 1, wherein said backrest includes a lumbar support portion projecting outwardly from said backrest in the area of the lumbar region of the back of a seated user, said lumbar support portion resiliently moveable about said flex points responsive to movement of a seated user.

9. A chair, comprising:
   - seat support structure;
   - a backrest frame connected to said seat support structure;
   - a backrest including a flexible body portion surrounding at least two rigid portions, said at least two rigid portions pivotally attached to said backrest frame at respective joints which are disposed proximate opposite sides of said backrest.

10. The chair of claim 9, wherein each said rigid portion is made from one of metal, plastic, and wood, each said rigid portion embedded within said flexible portion.

11. The chair of claim 9, wherein said rigid portions are respectively disposed along opposite sides of said backrest, said backrest frame having opposite ends respectively connected at said joints to said rigid portions.

12. The chair of claim 9, wherein said flexible portion is formed from one of a flexible urethane material and a flexible silicone material.

13. The chair of claim 9, wherein each said joint includes a flexible bushing member disposed between said backrest frame and said backrest rigid portion, said bushing members providing a return force against pivoting of said backrest at said joints.

14. The chair of claim 9, wherein each said rigid portion further comprises a spring member extending therefrom, said spring member embedded within said flexible portion.

15. The chair of claim 9, wherein said backrest includes a flexible upper portion, said upper portion moveable about said joints between a substantially upright position and a reclined position responsive to movement of a seated user.

16. The chair of claim 9, wherein said backrest includes a lumbar support portion projecting outwardly from said backrest in the area of the lumbar region of the back of a seated user, said lumbar support portion moveable about said joints responsive to movement of a seated user.

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