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(54) **ANATOMICALLY ADAPTIVE AND ERGONOMIC LOAD DISTRIBUTION STRAP**

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(52) **U.S. Cl.** **224/257**

(57) **ABSTRACT**

A system includes a strap made using a layer of resilient and pliant material such as neoprene. A cutout extends along the strap and ends at connecting areas of the resilient and pliant material, and a load can be connected to the connecting areas. When a user employs the system, a weight of the load is primarily applied to the user at a load bearing area of the strap including the cutout. In some embodiments, the strap may further include a curved edge that helps the strap conform to anatomy (e.g., a shoulder) of a user, and a swivel that connects the strap to extension straps.

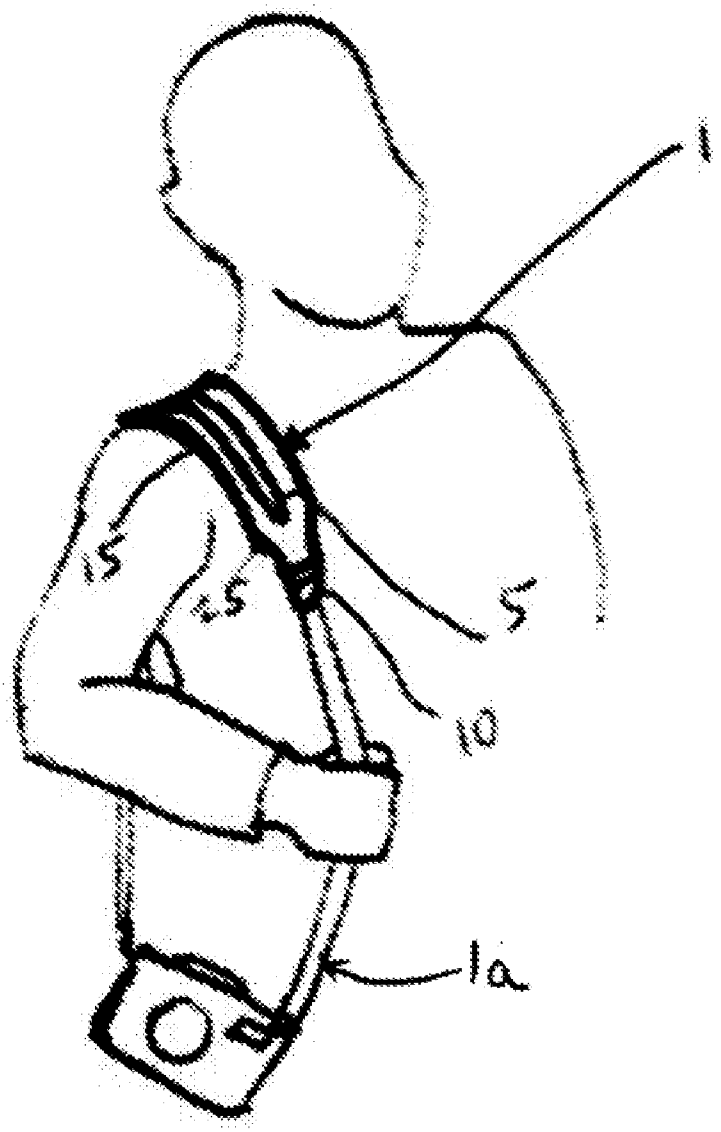


FIG. 1A.

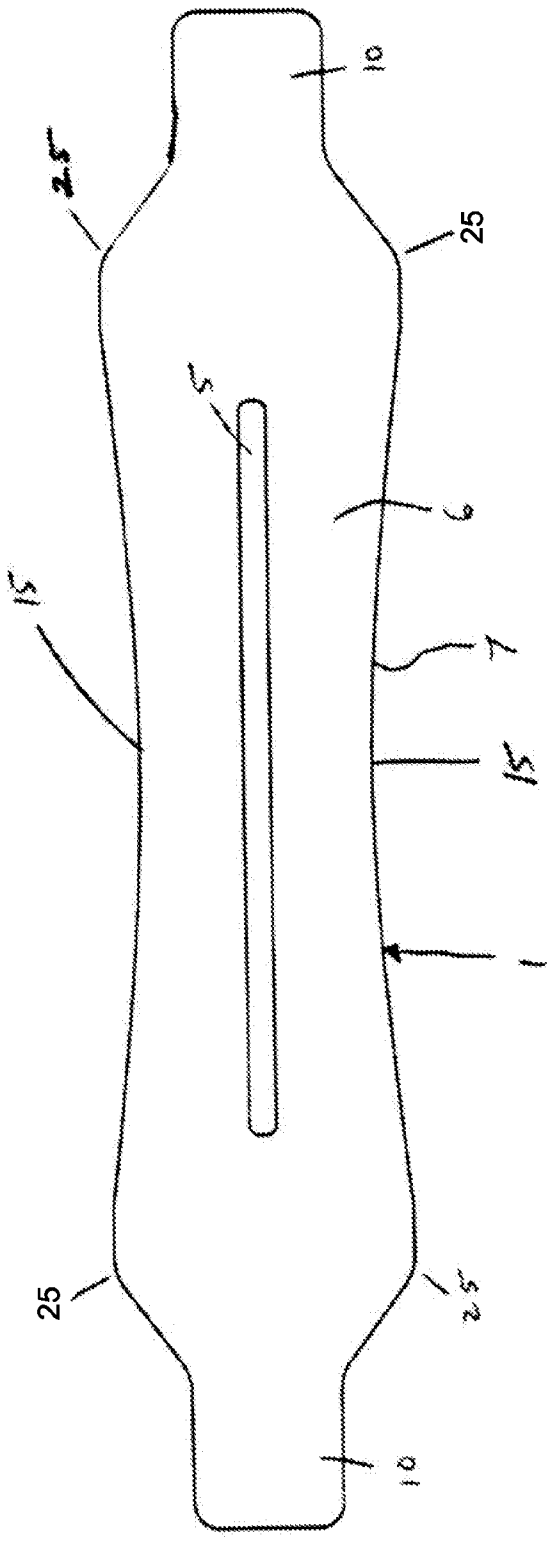


FIG. 1B.

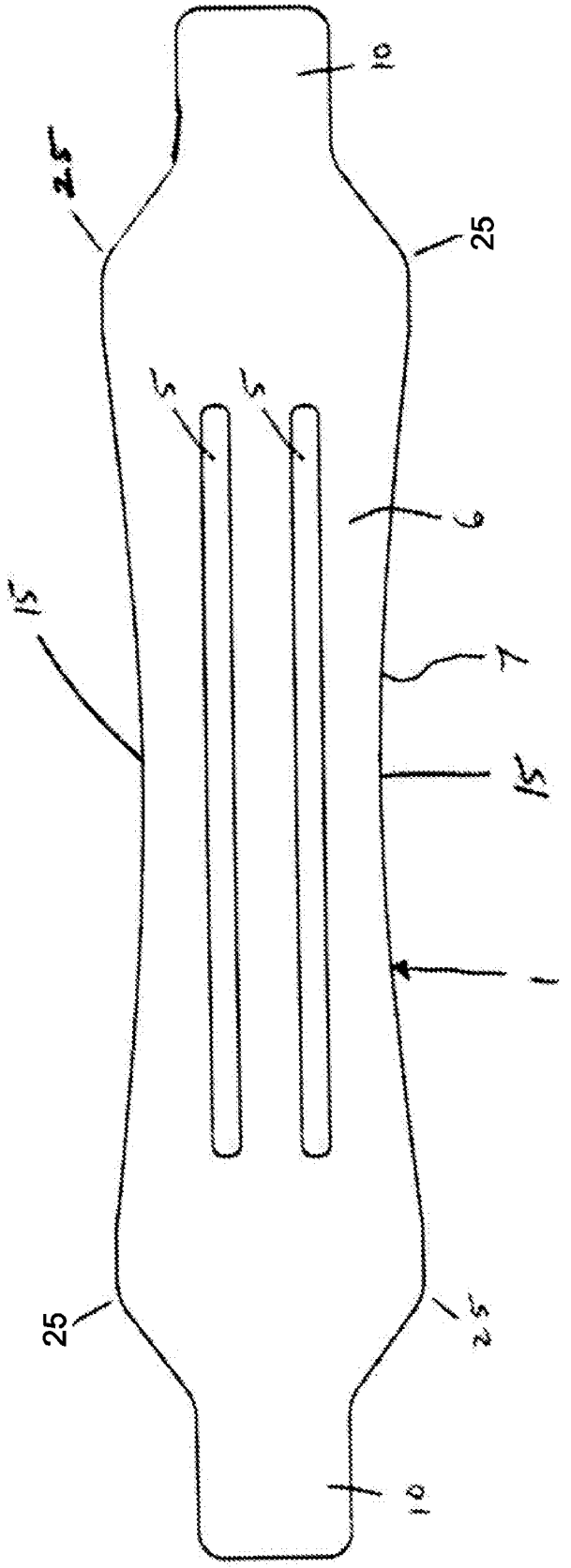


FIG. 1C.

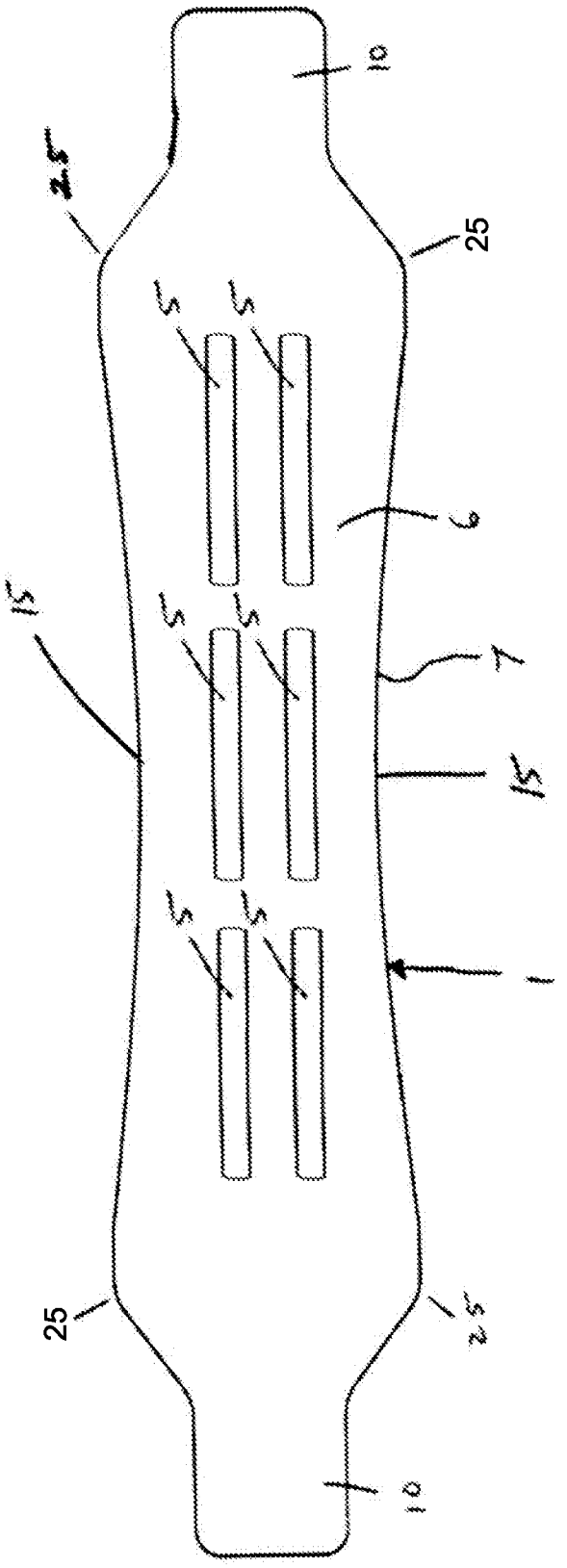


FIG. 1D.

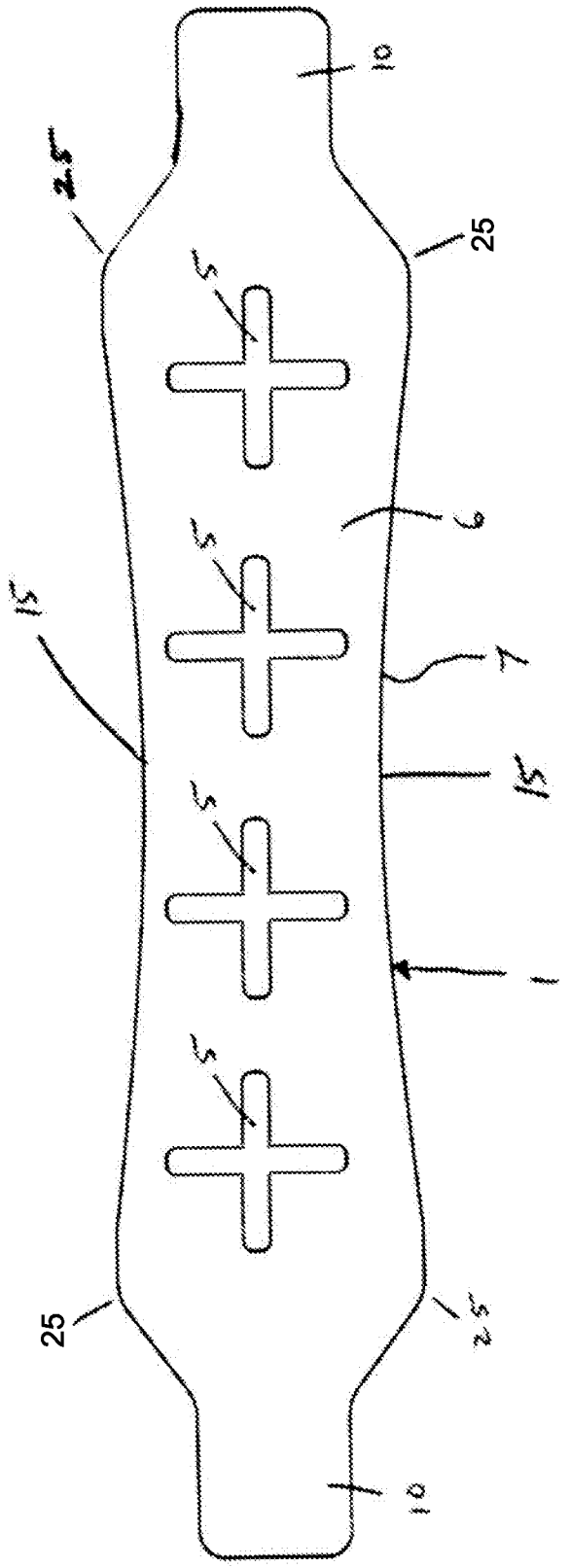


FIG. 2A.

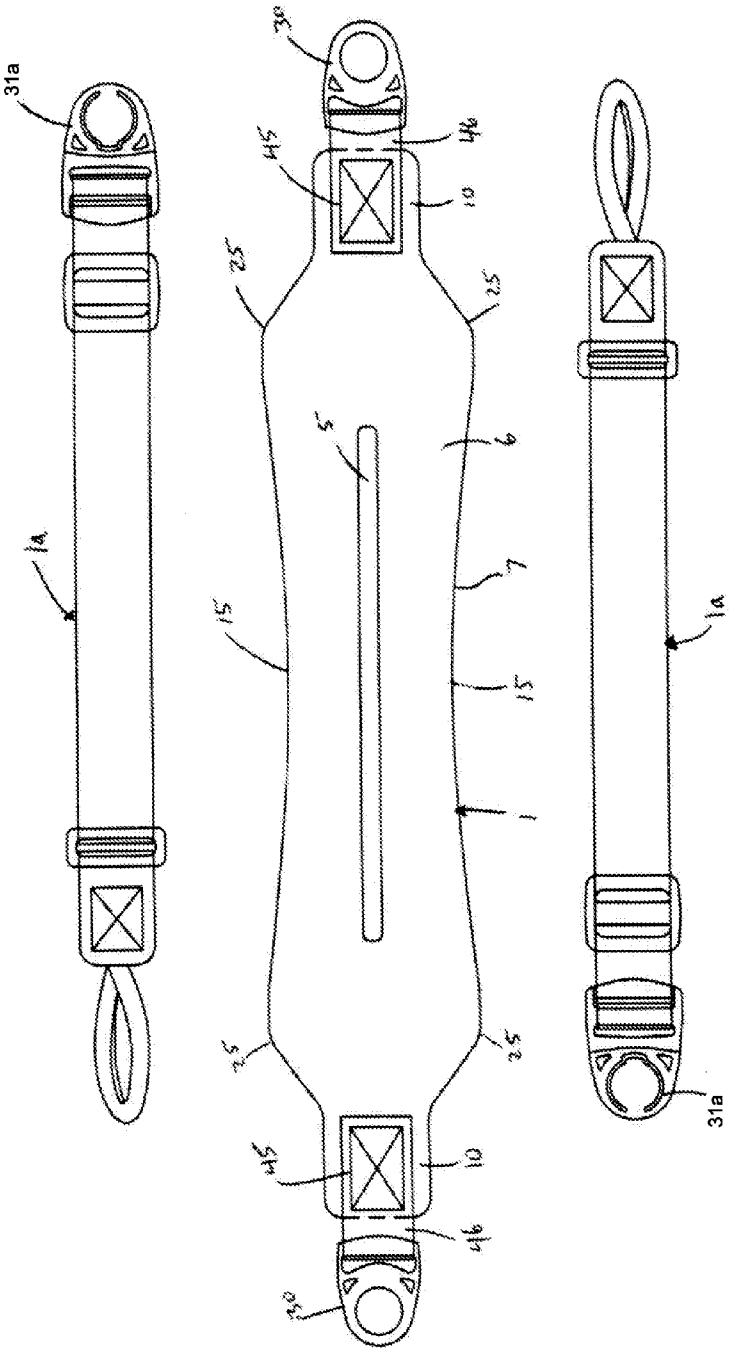


FIG. 2B.

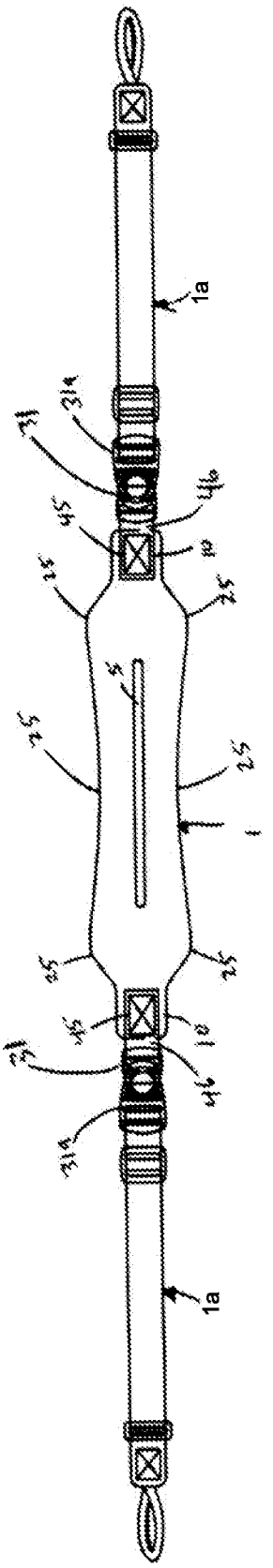


FIG. 3.

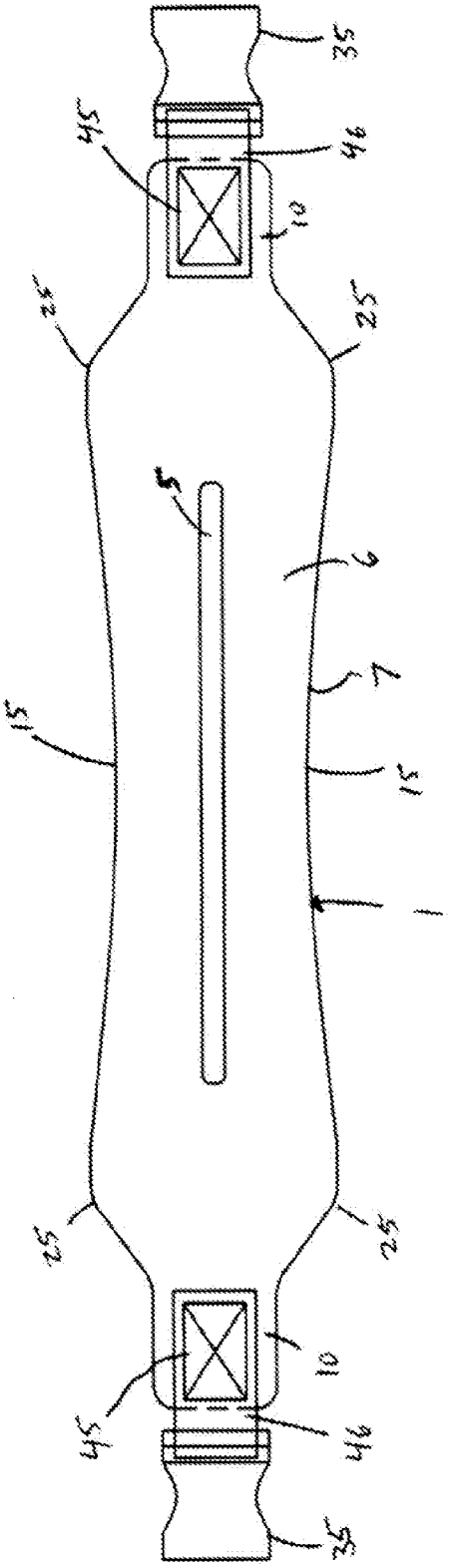


FIG. 4.

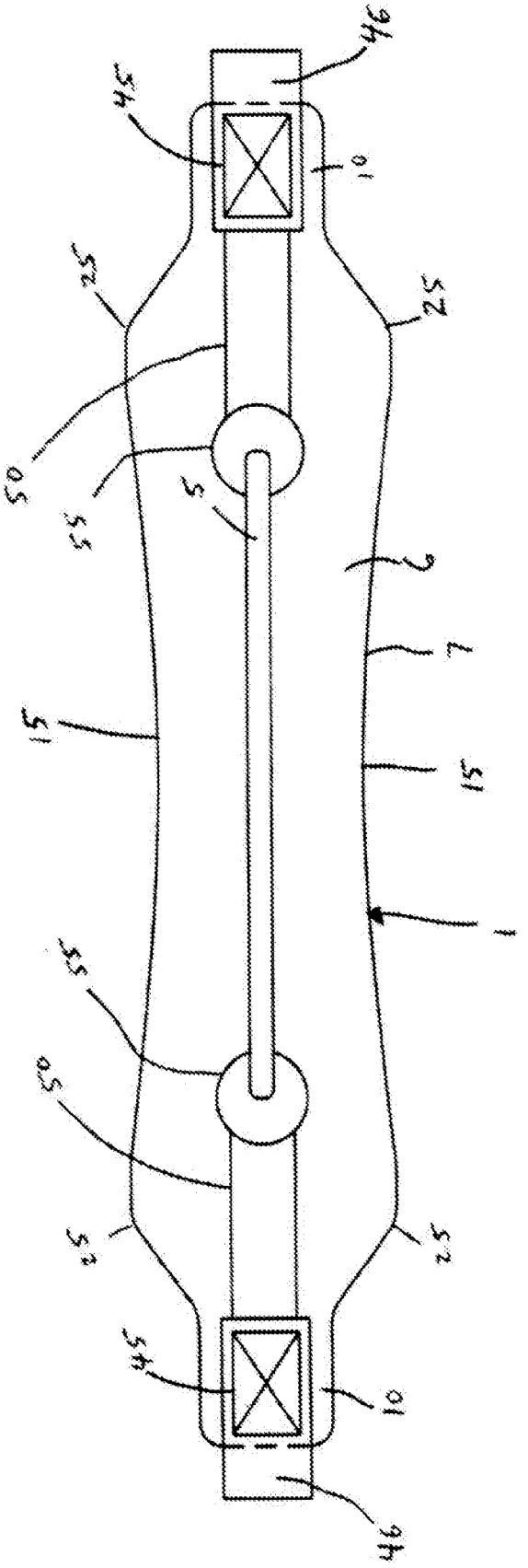


FIG. 5.

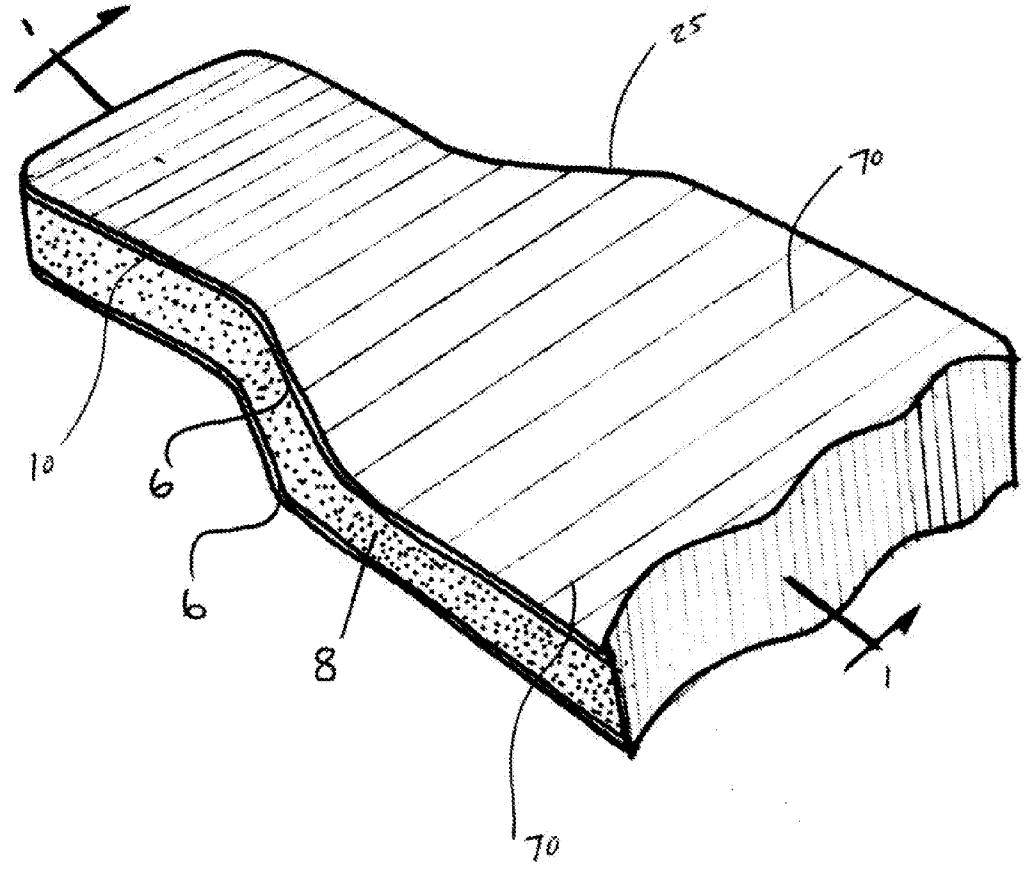


FIG. 6.

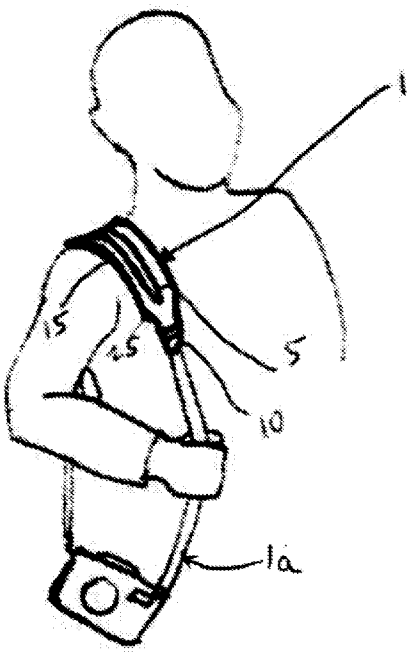


FIG. 7.

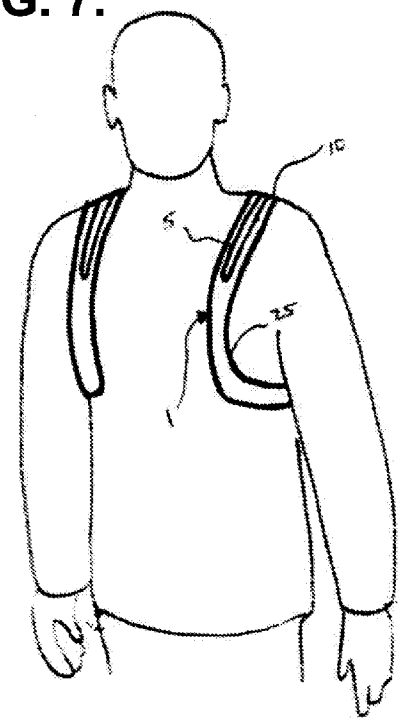


FIG. 8.

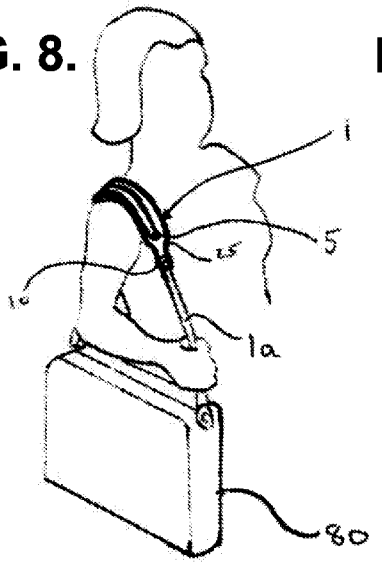
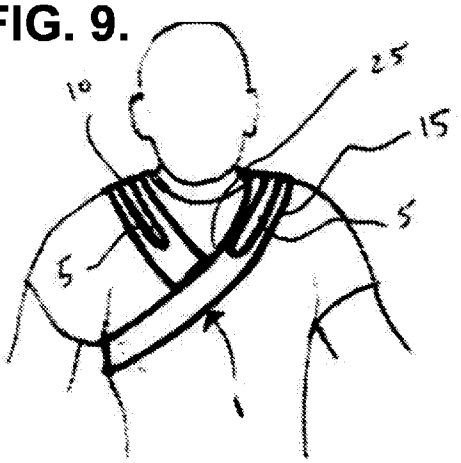


FIG. 9.



ANATOMICALLY ADAPTIVE AND ERGONOMIC LOAD DISTRIBUTION STRAP

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This patent document claims benefit of the earlier filing date of U.S. provisional Pat. App. No. 61/402,401, filed Aug. 30, 2010, which is hereby incorporated by reference in its entirety.

BACKGROUND

[0002] Straps and harnesses have long been used when people or animals carry or move large and/or bulky loads. Carrying heavy loads often causes discomfort that is generally attributed to the weight of the load, but the strap or harness may also be to blame for such discomforts. For instance, the straps on daypacks or backpacks that are commonly used by students have seen minimal improvement since such packs were originally introduced. Yet, the load and repetitive movement of a traditional strap of a backpack may cause strain, rashes, and undue injury. Still, students typically blame the weight of the items carried while not realizing that the strap or harness is actually a cause of their injuries. As such, cases of Repetitive Strain Injury (RSI) and Musculoskeletal Disorder (MSD) continue to rise.

[0003] One of the reasons prior carrying straps and harnesses were uncomfortable was that they were made with rigid and inflexible materials not limited to leather and fibrous strands. When carrying loads, the low surface area of a strap may cause the strap to dig in flesh, while the material of the strap rubs with the vibrations created by motion. The strap can thus become abrasive against the skin of the user, especially when the user is traversing rough or undulating terrain. A strap can thus become increasingly painful and likely to cause injury while carrying a load over a period of time. A person may be able to make adjustments when a strap becomes uncomfortable, but the discomfort of animals may not be detected until injuries are visible.

[0004] Advances have been made to improve the strap design by means of better materials such as neoprene foam as exemplified by U.S. Pat. No. 5,143,266 to Heckerman. However, simply dampening the repetitive impact created by a load may not be enough to reduce the possibility of injury since the load is commonly distributed as a downward pressure throughout injury prone areas.

SUMMARY

[0005] In accordance with an aspect of the invention, a strap or harness can provide a better force distribution by means of a cutout. In one configuration, the cutout is centered and runs longitudinally along a strap but terminates before the edge. The cutout can provide curved outer edges that are narrowest at the center to effectively create parallel members that facilitate and improve conformity even when compressed to anatomical features such as the acromion, trapezius, shoulder, and neck area. A strap system can thus redirect and divert a dynamic load from directly compressing sensitive nerves and muscles. The redirection may reduce pressure and aid recovery in a multitude of areas, including but not limited to: Repetitive Strain Injury (RSI), Musculoskeletal Disorder (MSD), neuromuscular disorders, orthopedic injuries, fatigue, and general discomfort. The cutout can also promote breathability in order to wick moisture and lessen the chance of rashes and other potential medical conditions.

[0006] A weakness of some previous strap and harness designs is the tendency to shift and slip as a result of the dynamic force causing a strap to slide over one plane, much like sliding on a sheet of ice. This slipping often causes a user to adjust the load and the position of weight over the body and reset how the straps sit on their shoulders. Some embodiments of the invention address the problem of slipping through the cutout channel creating two or more planes, thus reducing the drag of the leading edge by decreasing the overall surface tension created by the directional push and pull forces.

[0007] In accordance with another aspect of the invention, swivels at the ends of the strap and/or harness can create joints that allow extension straps to move independently from the main member. The independent movement may help to reduce strain and material rub, plus increase slack and reduce tension, giving the user more dynamic freedom by mimicking the pivoting action of anatomical joints rather than the strap cutting into the user. The swivels can also increase stability of the main static member.

[0008] In accordance with yet another aspect of the invention, the useful life of a strap can be extended by increasing the perceived value and overall usability. Such straps or harnesses can be integrated in, adapted for, or added to applications including but not limited to: undergarments, backpacks, binoculars, sporting goods, firearms, media recording devices, digital devices, messenger bags, golf bags, totes, purses, splint, parachutes, animal harnesses, remote control units, medical devices, tablets, computers, computer devices, moving straps, and other similar load bearing products. Other features may include modular members such as threads, clips, rings, and other types of connectors.

[0009] An additional or integrated feature of some embodiments of the invention is the use of low friction webbing or material that helps facilitate better movement for the strap and/or harness by decreasing the drag and increasing user comfort by reducing of texture in the material. Such material may also aid object movement and decrease getting snagged or tangled. Alternately, various materials, grain line cuts and reinforcement points can be used to improve the durability while keeping the main functionality of the invention intact.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIGS. **1**A, **1**B, **1**C, and **1**D show a portion of a strap system in accordance with alternate embodiments of the invention including a resilient and pliant strap that is shaped to contact a user.

[0011] FIGS. **2**A and **2**B show plan views of the upper side of a strap system in accordance with an embodiment of the invention including a strap and extension straps.

[0012] FIG. **3** is a plan view of the upper side of a strap in accordance with an embodiment of the invention including quick release buckles.

[0013] FIG. **4** is a plan view of a strap in accordance with an embodiment of the invention having reinforcement points.

[0014] FIG. **5** is a perspective view showing a cross section towards one end of a strap containing a resilient and pliant layer.

[0015] FIG. **6** shows a camera strap in accordance with an embodiment of the invention.

[0016] FIG. **7** shows backpack straps in accordance with an embodiment of the invention.

[0017] FIG. **8** shows bag straps in accordance with an embodiment of the invention.

[0018] FIG. **9** shows a medical splint or brace application in accordance with an embodiment of the invention.

[0019] Use of the same reference symbols in different figures indicates similar or identical items.

DETAILED DESCRIPTION

[0020] FIG. **1**A is a plan view of the upper side of a portion of a carrying strap or harness system in accordance with an embodiment of the invention. A harness or carry strap system includes a shoulder strap **1** that can be formed from neoprene or polychloroprene foam, rubber or synthetic rubber, or a similar resilient/pliable material. To provide sufficient strength, a strap formed from a material such as neoprene generally needs to be thicker and wider than a strap formed from leather or a fabric webbing that carries the same load. For example, in an embodiment where strap **1** is a neoprene shoulder strap for carrying the weight of a camera, strap **1** might be about 4 to 6 mm thick, about 7 to 8 cm wide, and about 35 to 40 cm long. However, a wide strap distributes the load over a wider anatomical area when the strap is used to carry a load. Strap **1** is further shaped to have at least one outer edge **15** that is curved, so that a load bearing area of strap **1** is narrowest at its center. The curved shape can provide a contoured, ergonomic, and custom molded fit to any anatomical feature. Alternatively, the width of strap **1** can be uniform to maximize the load-bearing area at its center. Corners **25** where the load carrying area transitions to connector areas **10** can be smoothed or rectangular depending on the application and width of the strap **1**.

[0021] Strap **1** further has a cutout **5** in the center of strap **1** and running longitudinally but terminating before the edge. The cutout **5** can have any width that is greater than zero but less than the width of strap **1**. Cutout **5** is straight in FIG. **1**A but can be in a variety of shapes and sizes to accommodate different applications. The length of cutout **5** can generally be greater than zero but less than the length of strap **1**. In use, cutout **5** can provide better force distribution and adaptable conformity when compressed to the anatomically targeted features of the body of a user. In particular, cutout **5** creates separate regions of strap **1** that can independently adjust to the angle or shape of a user's anatomy upon which the region rests. The separate regions in a shoulder strap can thus separately accommodate the different angles of the trapezius and deltoid muscle in the shoulder of a user.

[0022] Strap **1** with a single cutout **5** as shown in FIG. **1**A provides two regions that extend along the length of strap **1** and are able to separately conform to the anatomy of a user. However, other cutout configurations could be employed. FIG. **1**B, for example, shows an alternate embodiment in which strap **1** includes two cutouts **5** that are parallel to each other to create three regions that can separately conform to the angle of the anatomy supporting the strap **1**. FIG. **1**C shows another alternate embodiment of strap **1** which has six cutouts **5** that extend along the length of strap **1** but are shorter than cutout **5** of FIG. **1**A. By limiting the length of cutouts **5** in the configuration of FIG. **1**C, the transverse separations between the independent regions can be limited. FIG. **1**D shows an alternate embodiment with cutouts in different shapes, which may not only extend along the length of strap **1** but can also be perpendicular to the length of strap **1** to provide a different flexibility.

[0023] The features of strap **1** can make strap **1** more comfortable than prior straps when carrying heavy or awkwardly shaped objects for a long period of time. In particular, cutout **5** and curve on outer edge **15** provides additional comfort and stability by conforming to the anatomical features of the human body. In this way, strap **1** functions as a primary shock absorber that reduces the overall static and dynamic forces from the load carried.

[0024] One or both of the top and bottom surfaces of the strap **1** may be covered by a layer of more resiliently dense material or fabric **6**. Fabric **6** has two primary functions. One function is to reinforce strap **1** and increase durability of strap **1** by decreasing wear and tear on primary material (e.g., neoprene) of strap **1**. Another function of layer **6** is to provide a surface on which decorative designs, messages, grip surfaces, textures, or other utility enhancing adaptations can be applied. Moreover, to provide further durability, binding or elastic material may be stitched along the edges **7** of the strap **1**. Connector areas **10** at the ends of strap **1** are access points that allow mounting of strap **1** in many configurations for different uses. Connector areas **10** and the associated termination point can vary in design to accommodate different applications. For instance, a camera strap might have a different connector area and end than would the straps on a backpack or other items. In many applications, end **10** will be attached to another strap, a connector, a harness, or a material that braces the static and dynamic load of an object being carried.

[0025] FIGS. **2**A and **2**B show plan views of the upper side of a strap system including a neoprene foam strap **1** and extension straps **1***a*. In particular, FIG. **2**A shows body-contacting strap **1** and extension straps **1***a* as separate pieces, and FIG. **2**B shows body-contacting strap **1** and extension straps **1***a* connected together to form a strap system. Body-contacting strap **1** provides a load bearing area of a resilient and pliant material containing a cutout as described above, while extension straps **1***a* may be made of a conventional strap material such as nylon. In the illustrated embodiment, strap **1** has swivel components **30** at ends **10** for connection to matching swivel components **31** on extension straps **1***a*. Swivel components **30** and **31** create joints at the ends of strap **1** that allow extension straps **1***a* to move independently from strap **1**. The independent motion of extension straps **1***a*, which may connect to a load, may help to reduce strain, material rub, and sores where strap **1** contacts a user. The independent motion can also increase stability of the strap **1** by reducing the tendency of strap **1** to slip in response to movement of the forces that the load applies through extension straps **1***a*. The swivel component **30** or end attachment can secured on to strap **1** by a webbing **46** made from nylon or material with similar characteristics. Box stitches **45** or attachments are used to attach webbing or material **46** on to the strap **1**. Stitches **45** and webbing **46** can provide additional reinforcement to the ends of strap **1** to prevent the resilient material from losing memory when stretched.

[0026] FIG. **3** is a plan view of the upper side of a neoprene foam strap with quick release buckles **35** attached to ends **10** of strap **1**. Quick release buckles **35** provide a quick method to connect and disconnect strap **1** from an object or load. Quick release buckles **35** can be used in combination of separate swivel components **30** (such as shown in FIGS. **2**A and **2**B) or can be integrated with a swivel to form a quick release swivel buckle.

[0027] FIG. **4** is a plan view of the upper side of a neoprene foam strap **1** with reinforcement points that improve durability and decrease the likelihood of the strap stretching, tearing, or being damaged from load-out or activities pushing the limits of the material. In this embodiment reinforcement mounting points **55** are at the ends of cutouts **5**. The mounting points **55** may be composed of a fabric material that is less elastic than the resilient material portion of strap **1**. Additionally, reinforcement webbing **50** formed from a durable hybrid fabric, such as nylon or other elastic webbing, is attached to mounting points **55** and to the box stitches **45** or alternately near the end of the strap. A loop may be formed from reinforcement webbing **50**, so that webbing **50** becomes taut and takes up the burden of the load carried by strap **1** before forces stretching strap **1** exceed the material elasticity limit, thereby preventing strap **1** from tearing. In yet another embodiment, reinforcement webbing **50** further runs the longitudinal length of the strap **1**, but then webbing **50** may hinder comfort and anatomical contouring of cutout **5**.

[0028] FIG. **5** is a perspective view of an embodiment of strap **1** showing a cross section towards one end **10** of a strap **1** containing a central neoprene layer **8** sandwiched between fabric layers **6**. A thickness of strap **1** is chosen to result in the best combination of comfort and resilience to the load carries. For example, the thickness of neoprene layer **8** can vary from 1 mm to 20 mm with a typical thickness of 4 mm to 6 mm for straps that people use to carry typical loads. Each layer of nylon fabric **6** contains grain lines **70** that influence the elasticity of strap **1**. Aligning grain lines **70** parallel to the length of the strap will result in a stiffer and less elastic strap. On the other hand, aligning grain lines **70** perpendicular to the length of strap **1** may result in a more elastic and hence more comfortable strap. The grain line **70** alignment can be chosen in such a manner to maximize comfort and bear the carried load without excess stretch.

[0029] FIG. **6** shows a version of strap **1** being used in a camera strap application. FIG. **6** particularly illustrates how the contoured edges **15** of strap **1** and cutout **5** allow strap **1** to better conform to the anatomy, e.g., shoulder and neck, of a user.

[0030] FIG. **7** shows a pair of straps **1** used in a backpack application. In particular, a pair of straps **1** including neoprene portions having cutouts **5** and contoured edges are the primary structures applying the weight of a load to the anatomy of a user. Ends **10** of straps **1** can connect to a knapsack either in a conventional manner or using swivels as described above. Alternatively, a pair of straps **1** can be used across, around, or on the shoulders where ends **10** connect to a harness or extension strap for carrying objects such as hydration bags, snowboards, skateboards, skis, and chest-facing carrier applications including laptops, selling concession items, and baby carriers to name a few.

[0031] FIG. **8** shows a version of strap **1** being used in a laptop, purse, or messenger bag application. As described above strap **1**, which may include neoprene with a cutout **5** and contoured edges rests on a user's shoulder and connects to a bag **80** via extension straps **1** a.

[0032] FIG. **9** shows a version of strap **1** being used in a medical splint, sling, or brace application.

[0033] Although the invention has been described with reference to particular embodiments, the description is only an example of the invention's application and should not be taken as a limitation. Various adaptations and combinations of features of the embodiments disclosed are within the scope of the invention as defined by the following claims.

What is claimed is:

1. A system comprising a shoulder strap that includes:
connecting areas; and
a load bearing area with a cutout extending along the shoulder strap in the load bearing area and ending at connecting areas.

2. The system of claim **1**, wherein the shoulder strap comprises a layer of a resilient and pliable material.

3. The system of claim **2**, wherein the resilient and pliable material comprises neoprene.

4. The system of claim **2**, wherein the shoulder strap further comprises a layer of fabric attached to the layer of resilient and pliant material.

5. The system of claim **1**, further comprising:
a swivel connector attached to one of the connecting areas; and
an extension strap attached to the swivel connector in a manner creating a joint between the shoulder strap and the extension strap.

6. The system of claim **5**, further comprising a load connected to the extension strap.

7. The system of claim **1**, wherein the system is selected from a group consisting of a camera strap, a backpack, a laptop strap, a bag strap, and an arm sling.

8. The system of claim **1**, wherein the shoulder strap has an outer edge that is curved so that the load bearing area of the shoulder strap is narrowest at a center of the load bearing area.

9. The system of claim **1**, wherein the load bearing area further comprises a second cutout, wherein the cutouts create a plurality of regions able to separately conform a user.

10. A system comprising:
a strap including a layer of resilient and pliant material having a cutout that extends along the strap and ends at connecting areas of the resilient and pliant material; and
a load connected to the connecting areas, wherein when a user employs the system, a weight of the load is primarily applied to the user at a load bearing area of the strap including the cutout.

11. The system of claim **10**, wherein the layer of resilient and pliant material has an outer edge that is curved so that the load bearing area of the shoulder strap is narrowest at a center of the load bearing area.

12. The system of claim **10**, wherein the resilient and pliable material comprises neoprene.

13. The system of claim **10**, wherein the strap further comprises a layer of fabric attached to a surface of the layer of resilient and pliant material.

14. The system of claim **10**, further comprising:
a swivel attached to one of the connecting areas; and
an extension strap attached to the swivel in a manner creating a joint between the strap and the extension strap.

15. The system of claim **13**, wherein the load connects to the extension strap.

16. The system of claim **10**, wherein the load comprises a bag.

17. The system of claim **10**, wherein the strap further comprises a second cutout that extends along the strap and ends at the connecting areas of the resilient and pliant material.

* * * * *