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(54) **LOAD-CARRYING DEVICE ATTACHED TO THE USER'S BODY, A SET FOR RETROFITTING SUCH A LOAD-CARRYING DEVICE, AND A METHOD FOR RETROFITTING SUCH A LOAD-CARRYING DEVICE**

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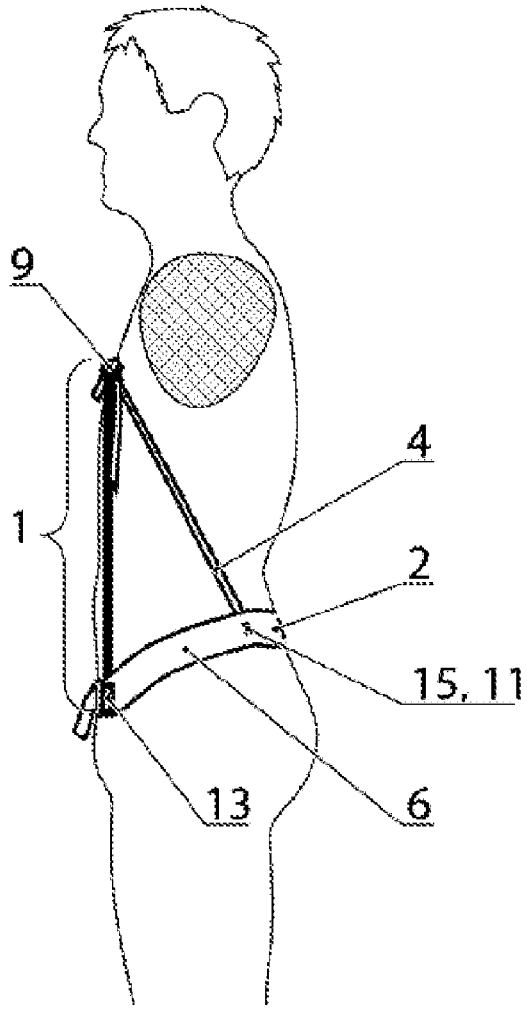
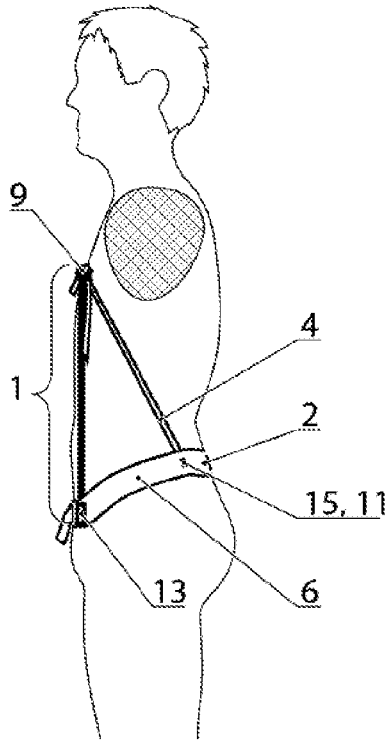
(57) **ABSTRACT**

A device includes a front brace (**1**), a non-stretchable lumbar brace (**2**), and a right and left under-shoulder strap (**3**,**4**) and right and left hip strap (**5**, **6**). All the straps (**3**, **4**, **5**, **6**) are non-stretchable and the under-shoulder straps (**3**, **4**) are adjustable in their length. The front brace (**1**) has attachment points (**8**, **9**, **12**, **13**) to the front ends the ends of all straps (**3**, **4**, **5**, **6**) and the lumbar brace (**2**) has attachment points (**10**, **11**, **14**, **15**) to the rear ends of these straps. Attachment points (**8**, **9**) for under-shoulder straps (**3**, **4**) to the front brace (**1**) are above the attachment points (**12**, **13**) of the hip straps (**5**, **6**) to this brace (**1**). Attachment points (**8**, **9**) for under-shoulder straps (**3**,**4**) to the front brace (**1**) are located above their attachment points (**10**, **11**) to the lumbar brace (**2**).





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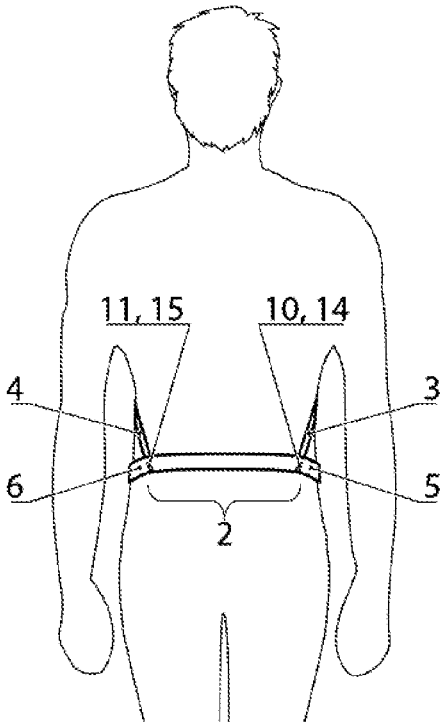

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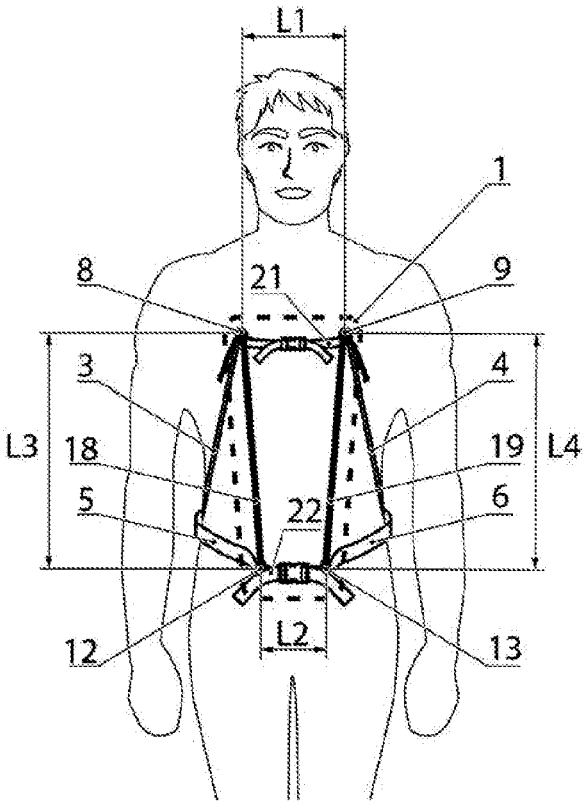

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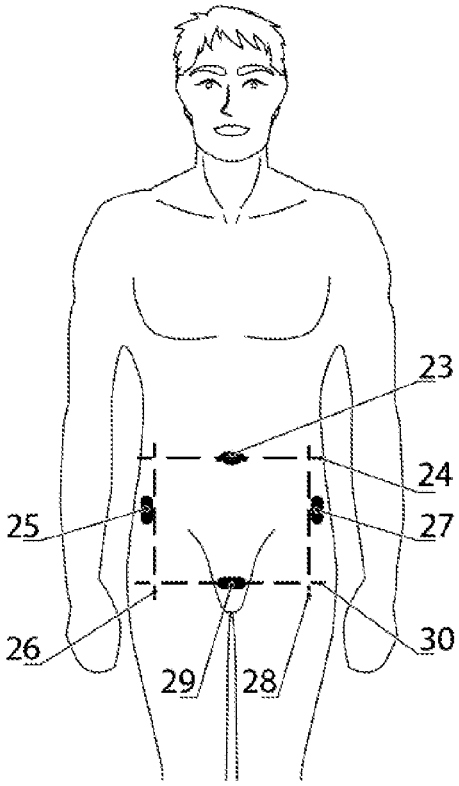

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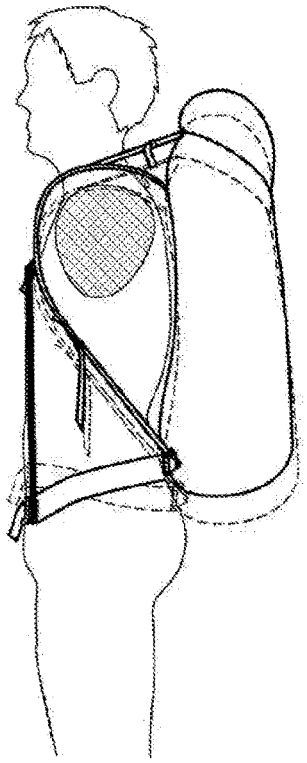

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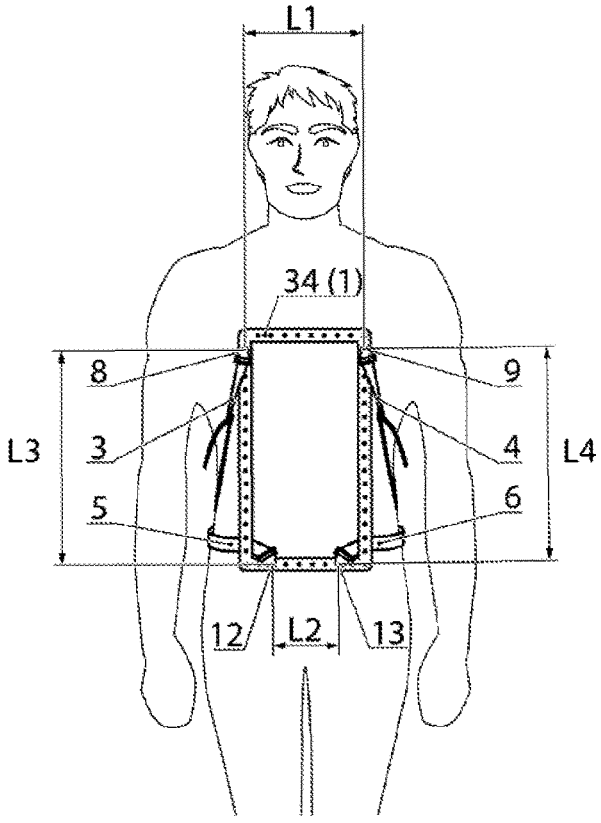

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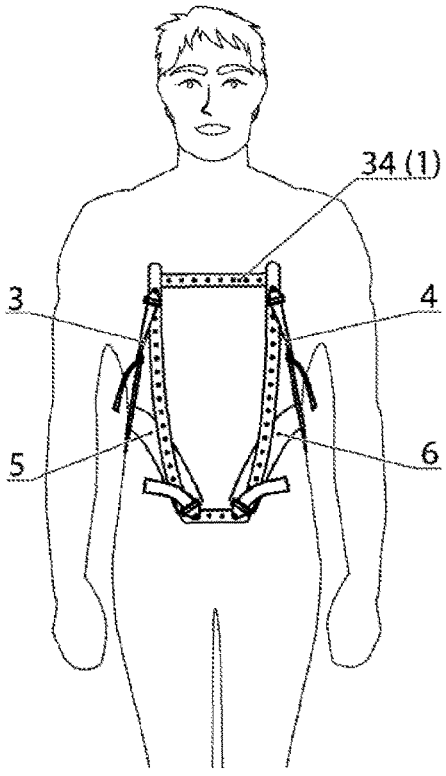

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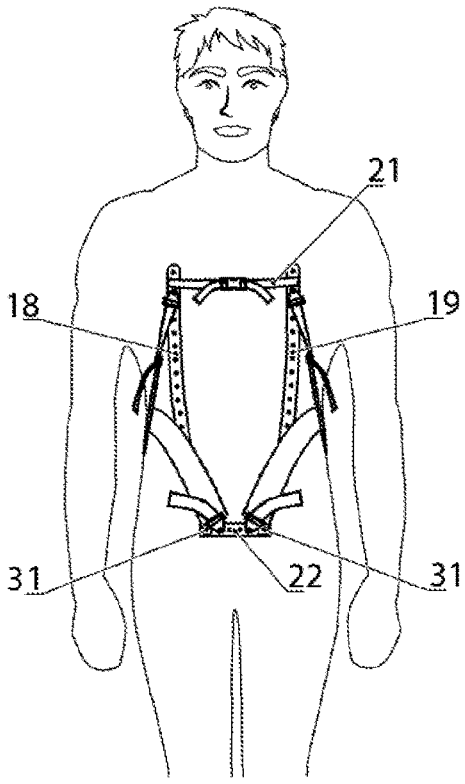

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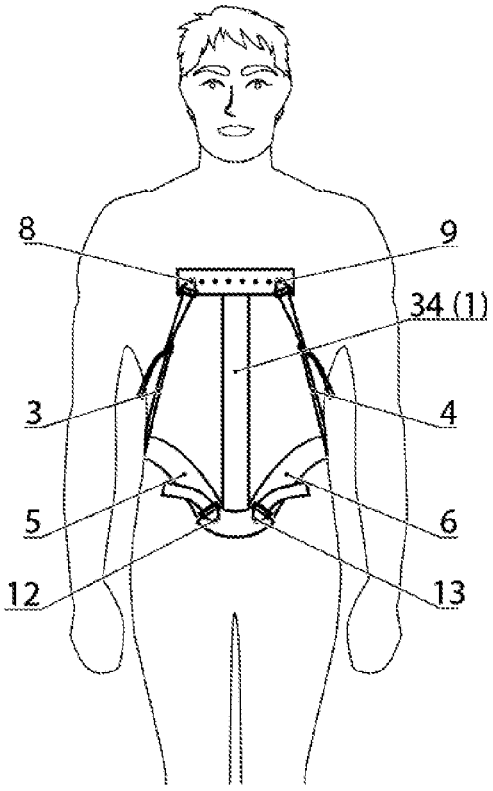

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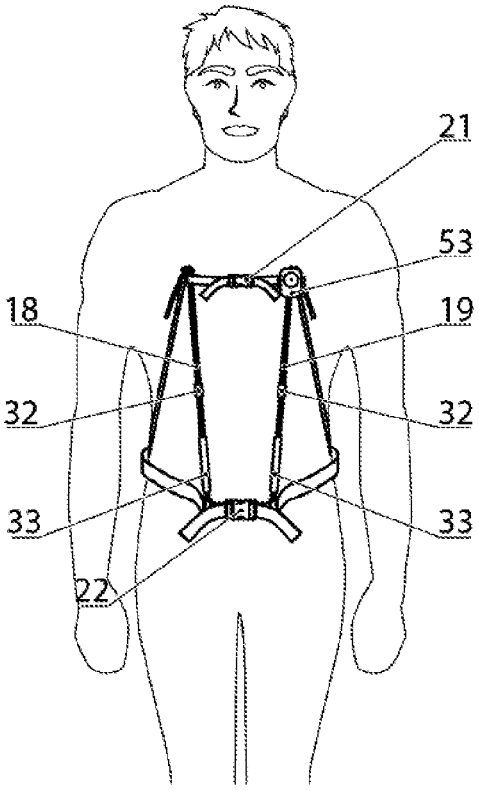

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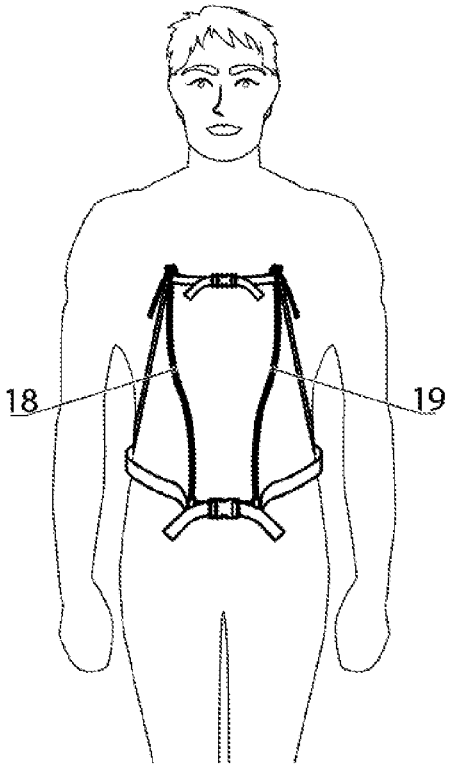

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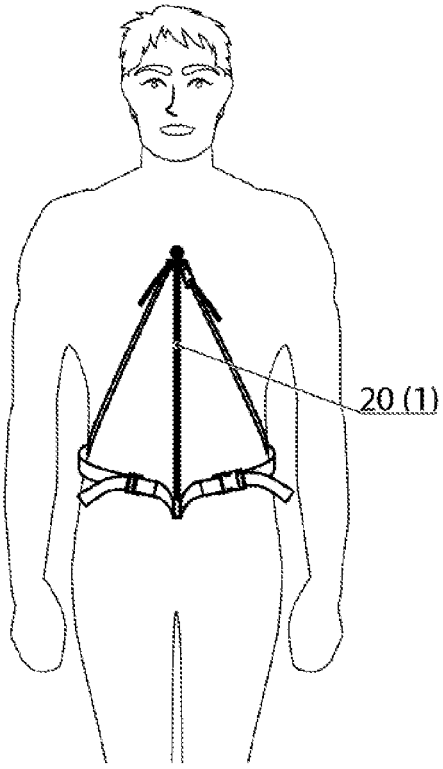

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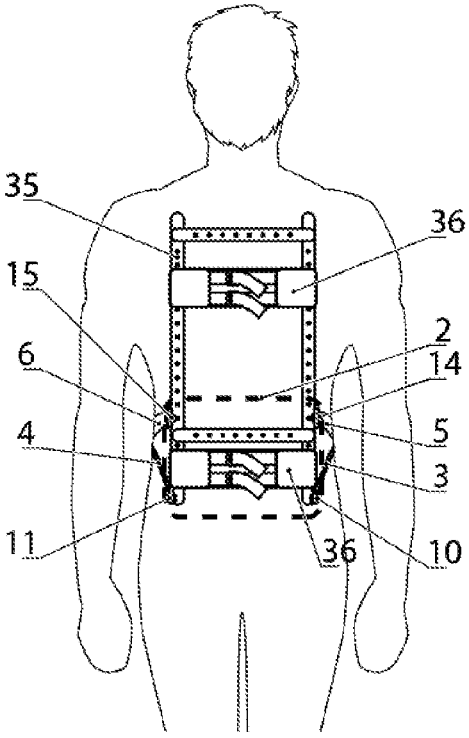

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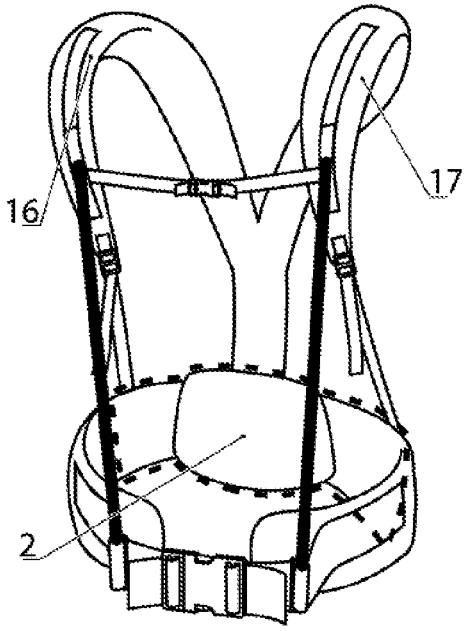

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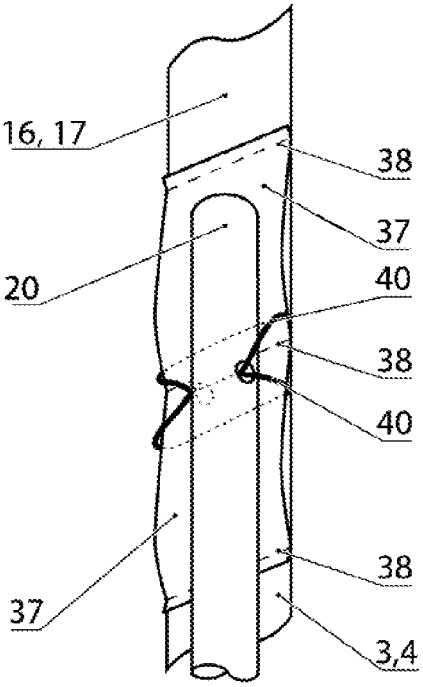

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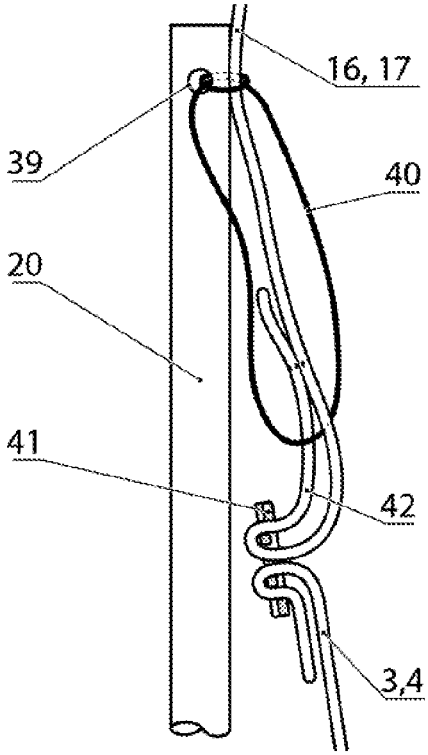

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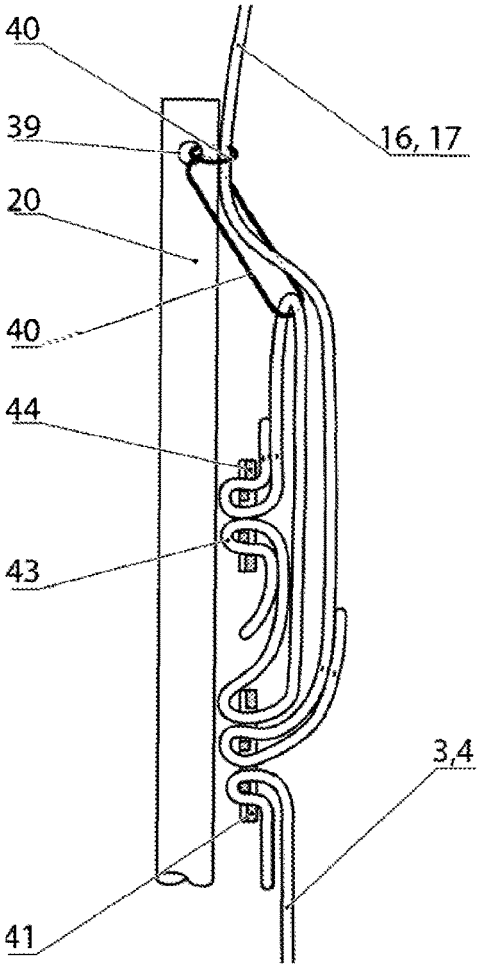

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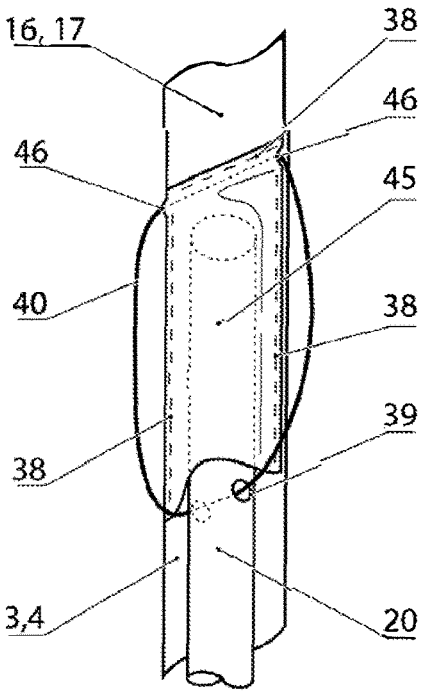

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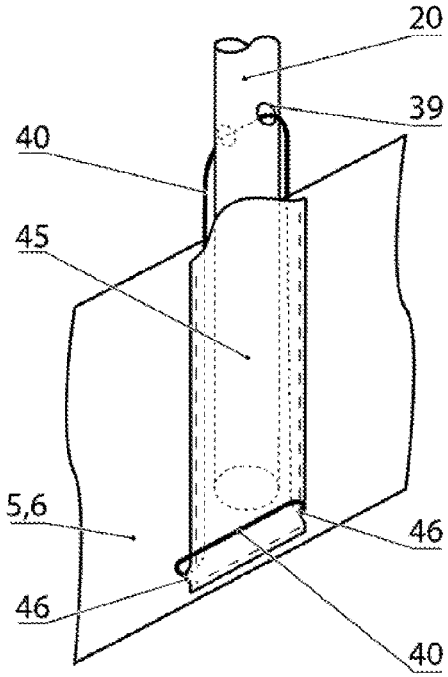

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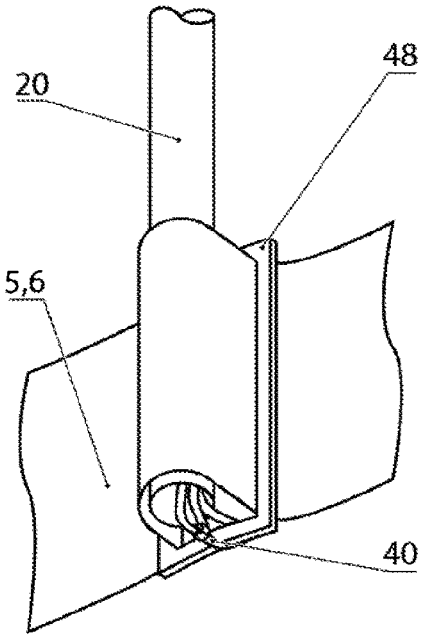

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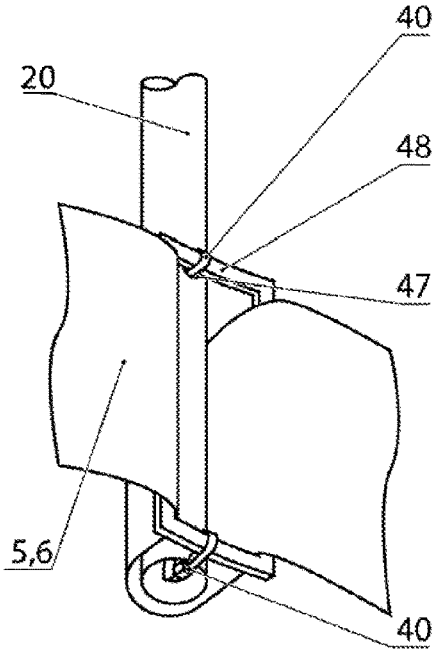

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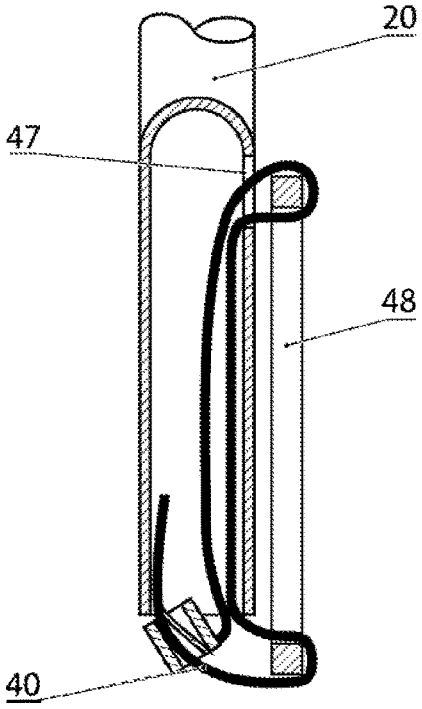

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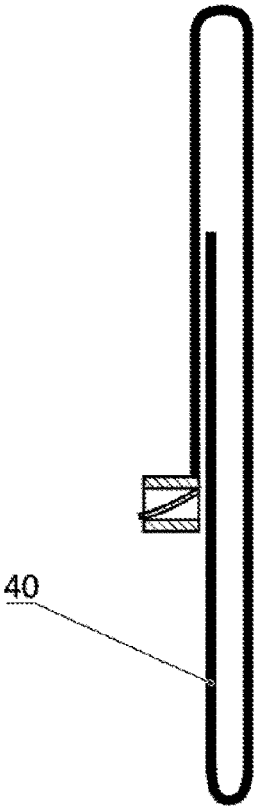

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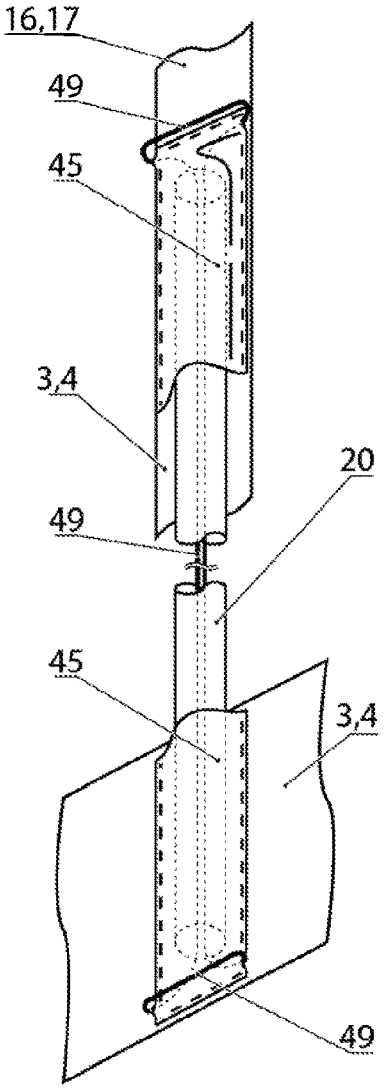

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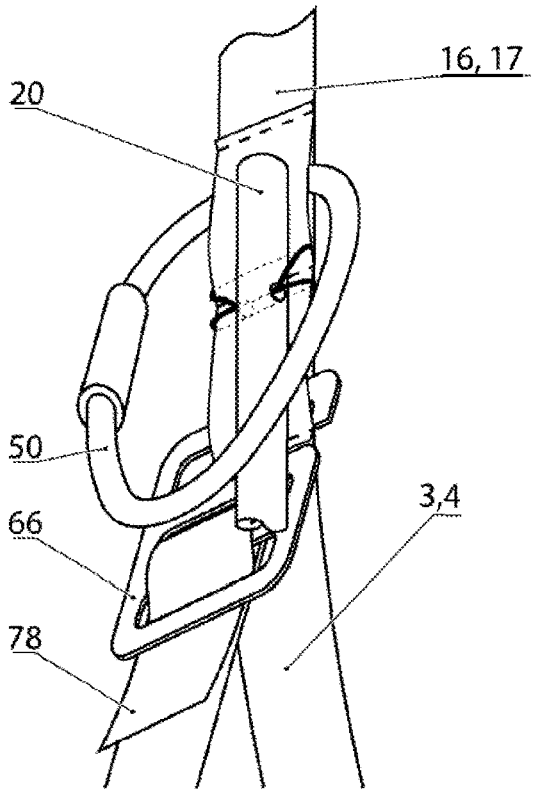

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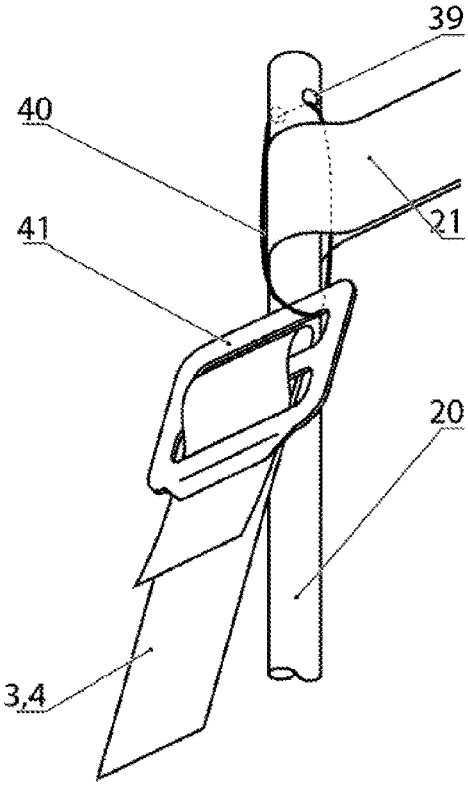

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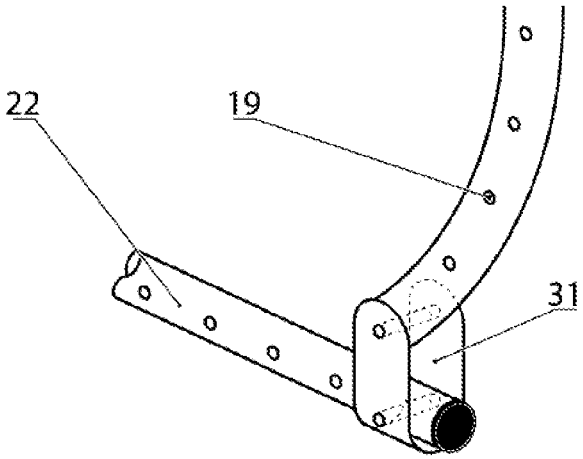

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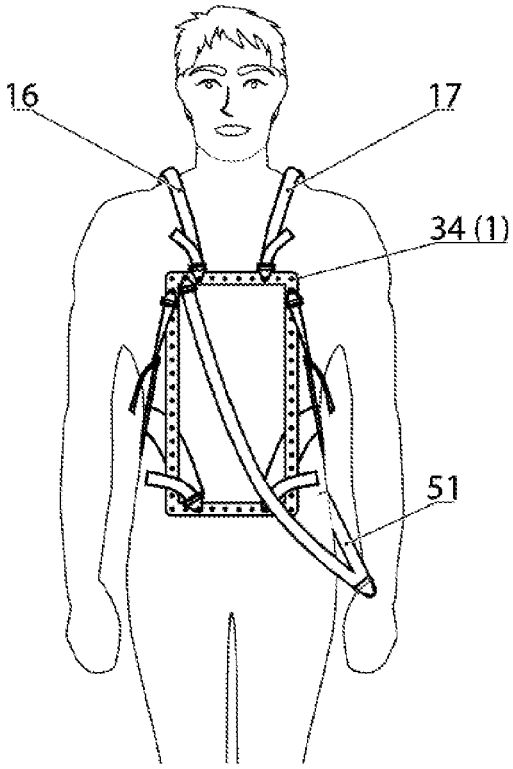

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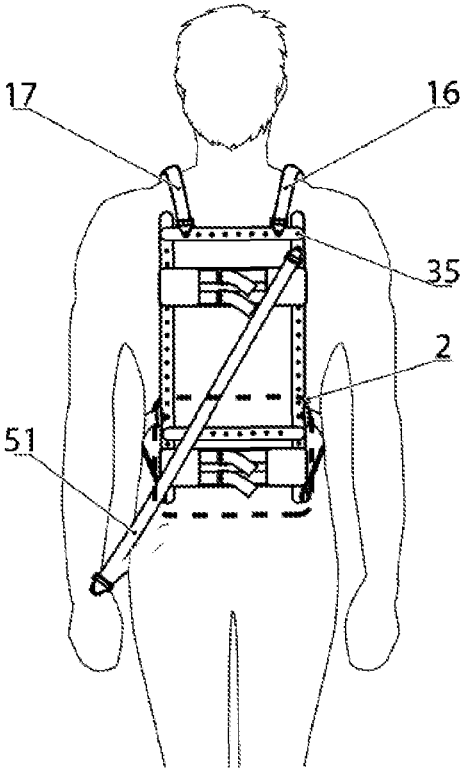

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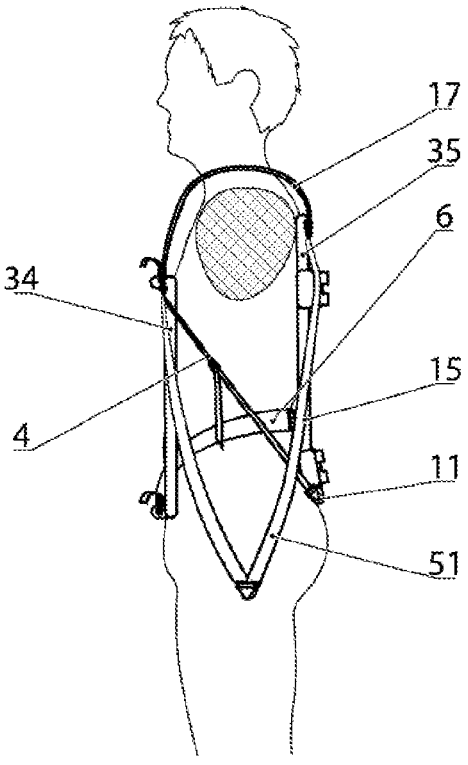

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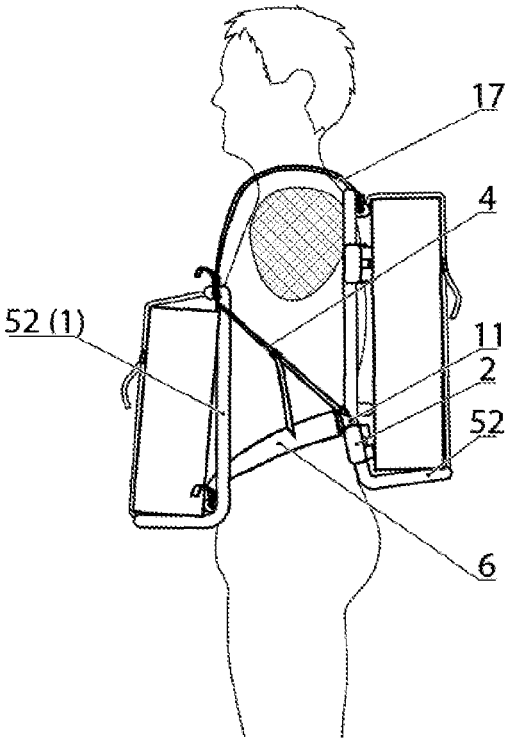

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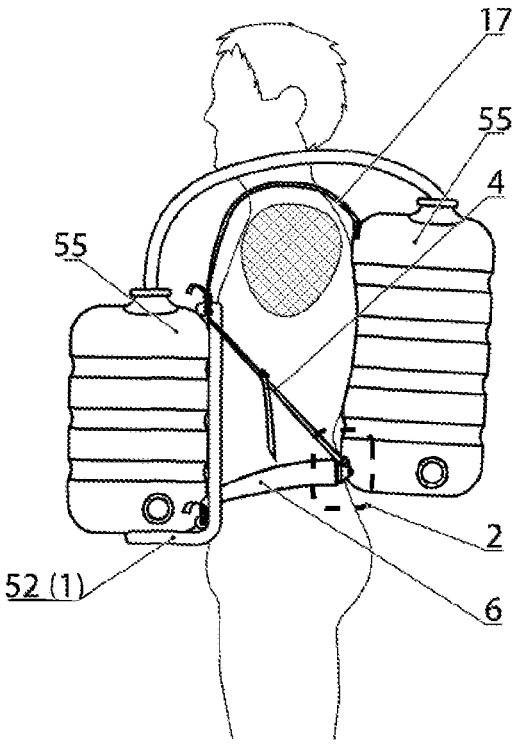

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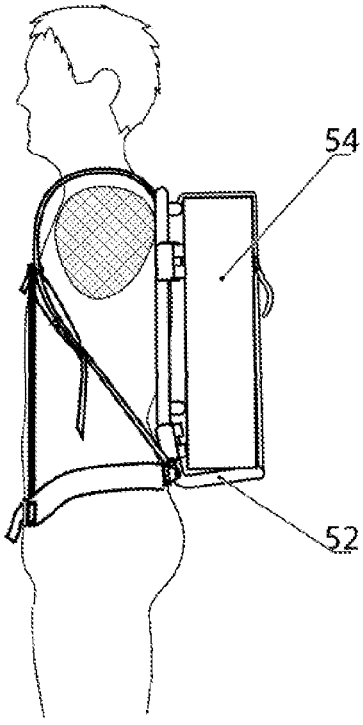

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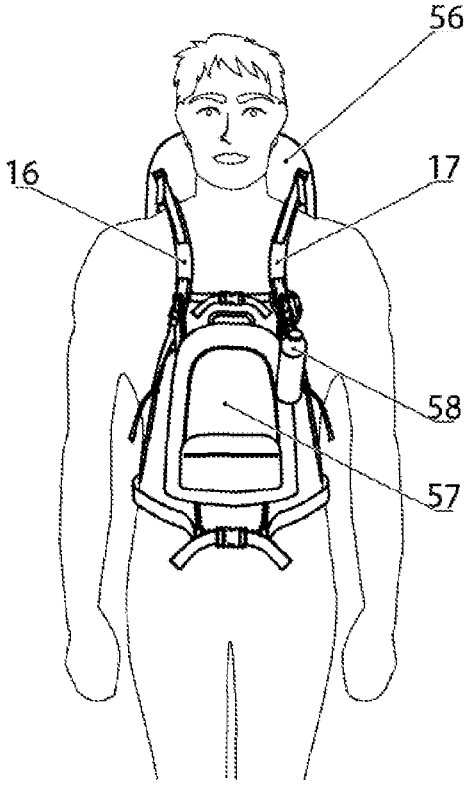

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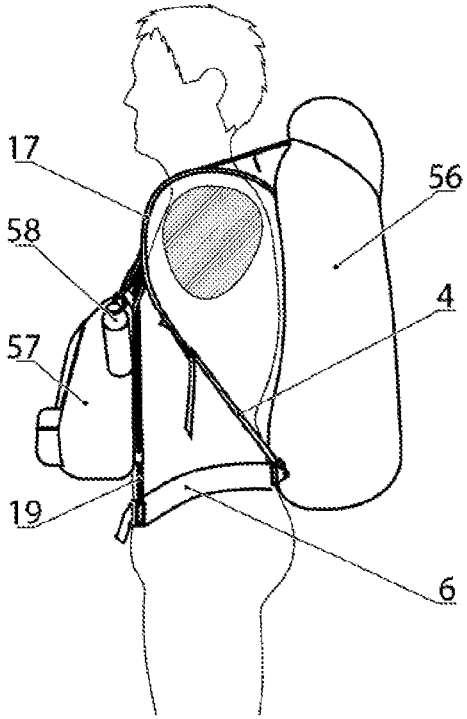

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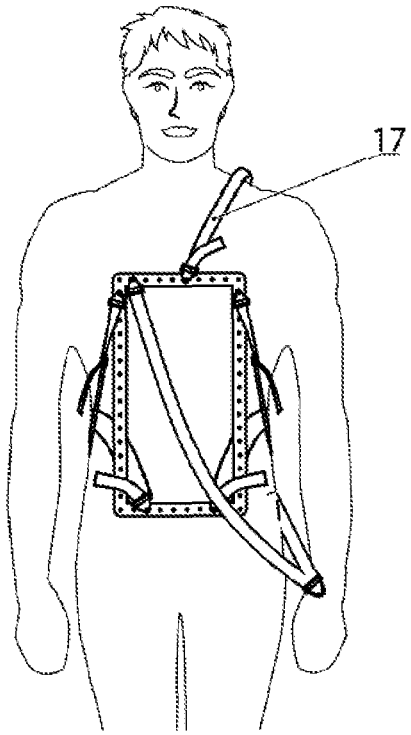

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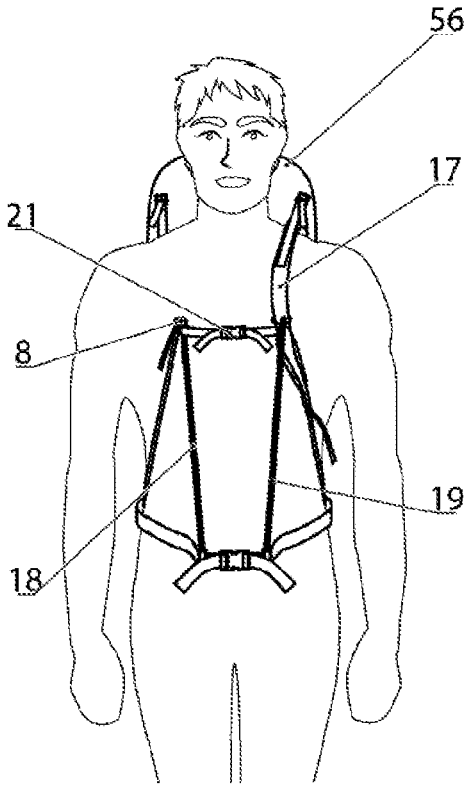

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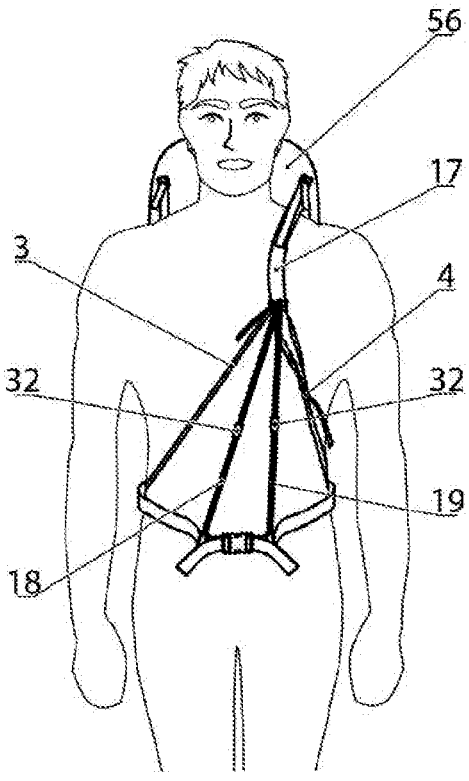

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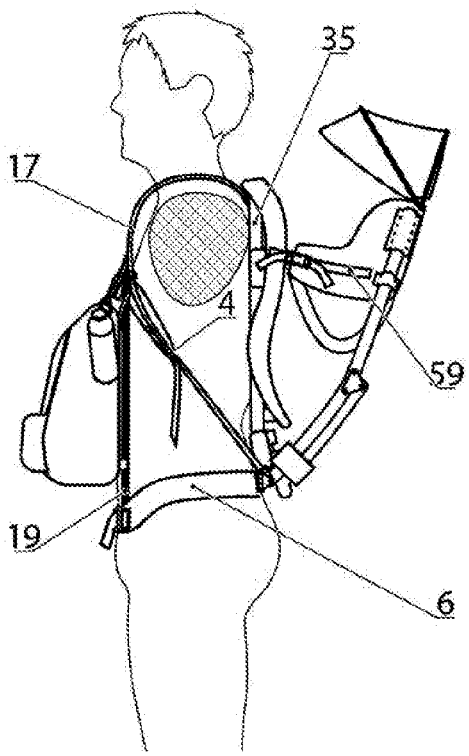

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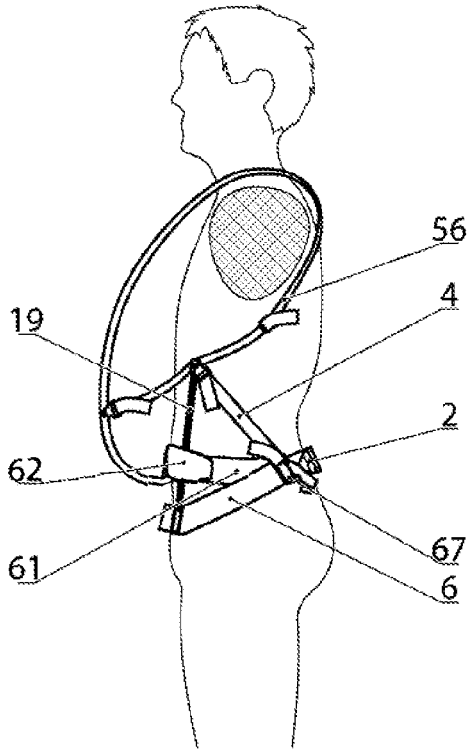

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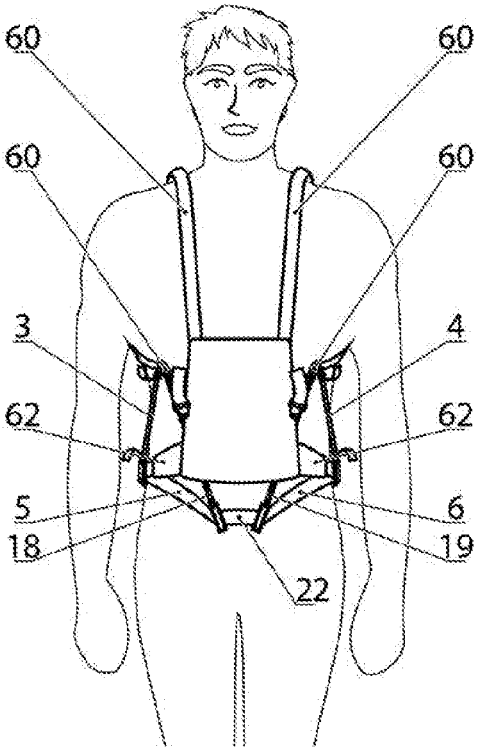

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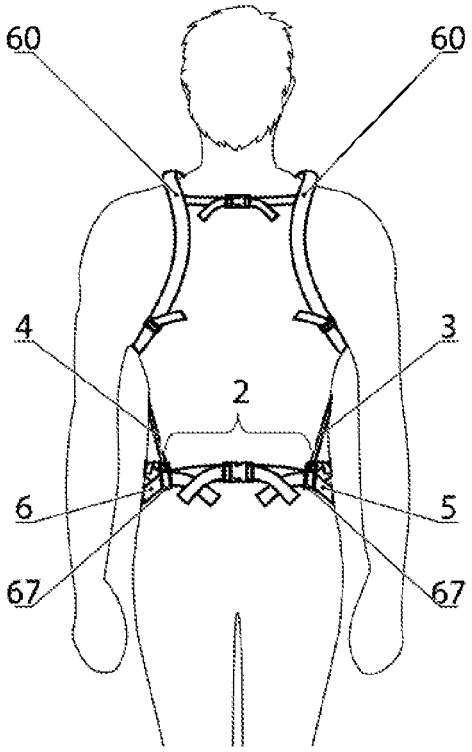

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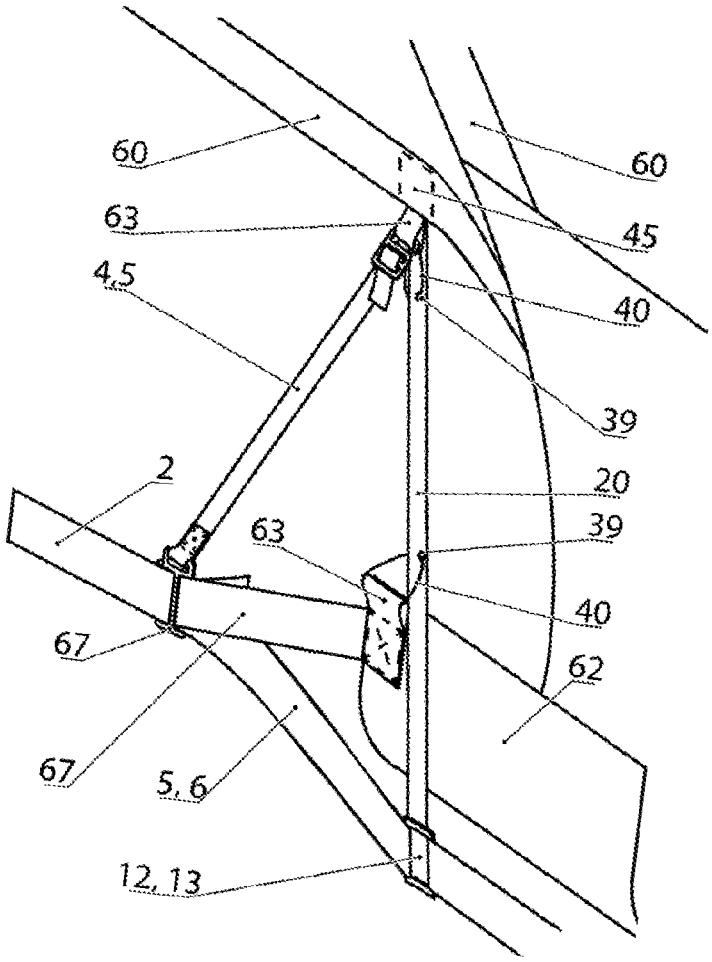

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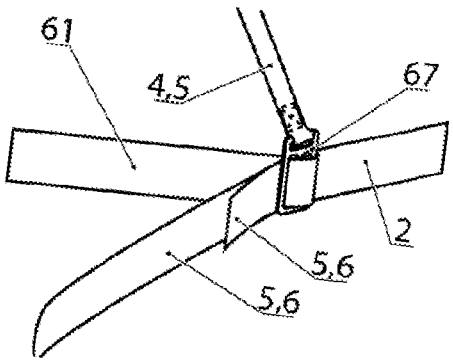

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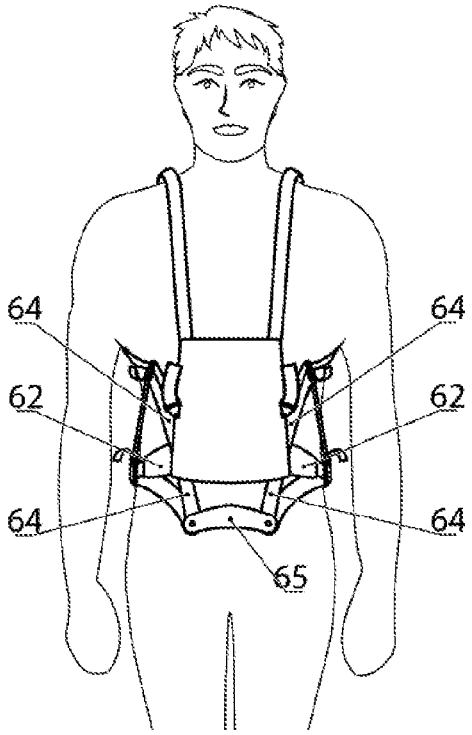

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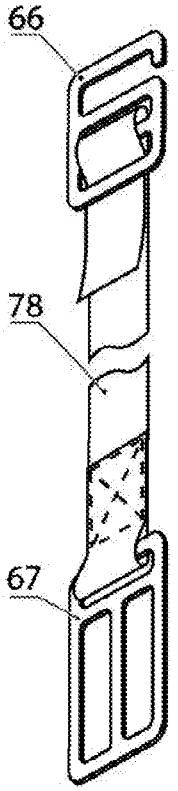

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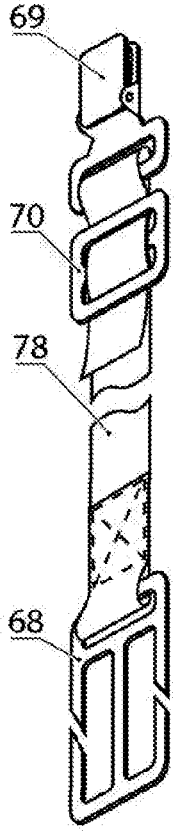

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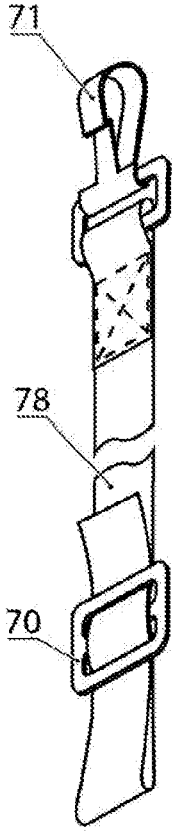

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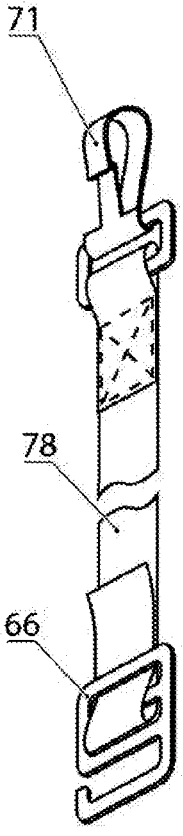

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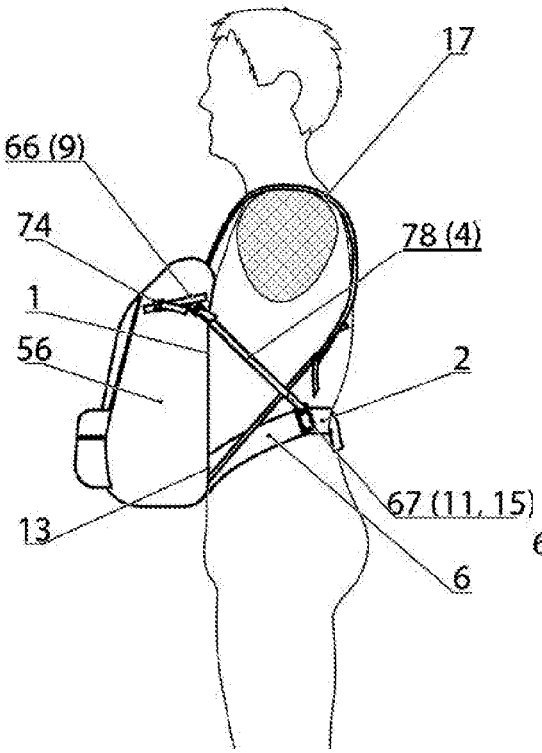

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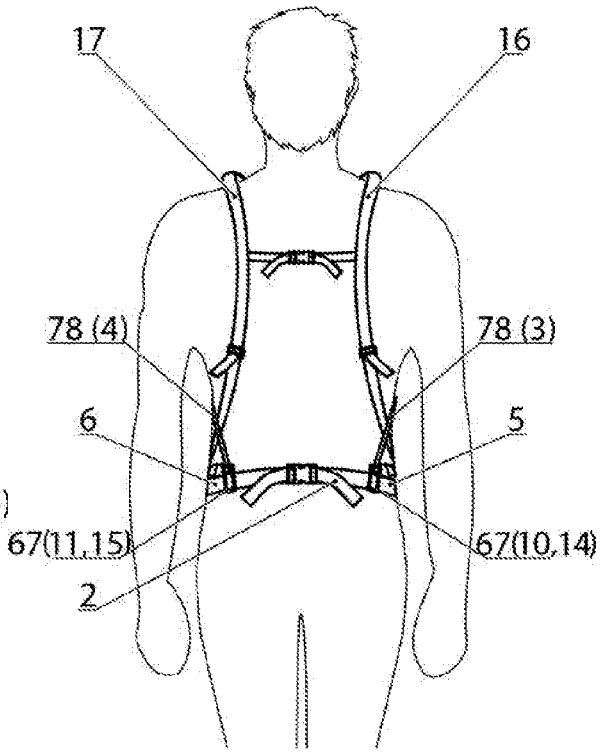

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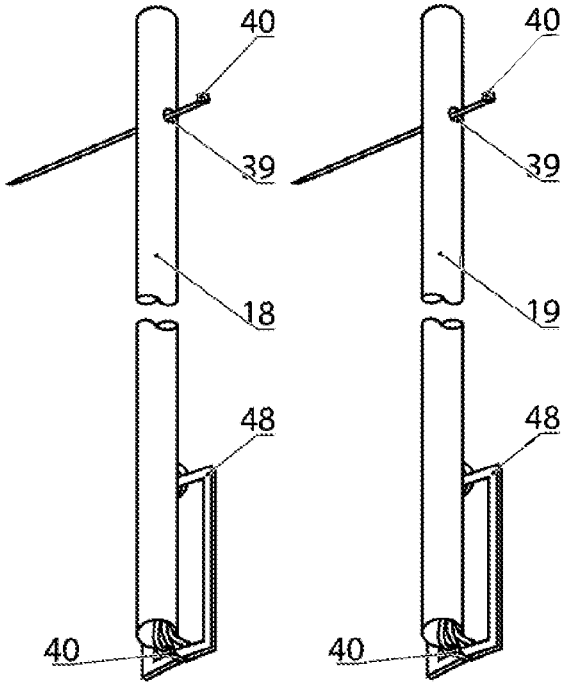

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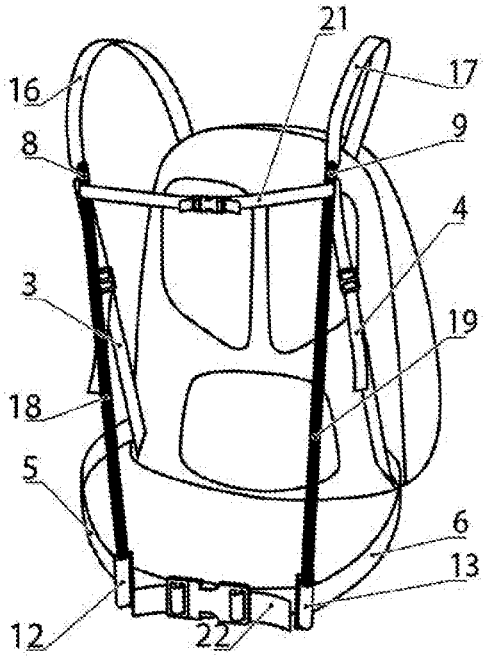

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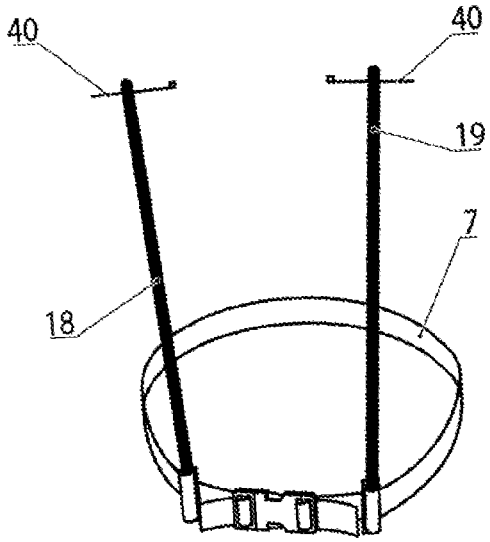

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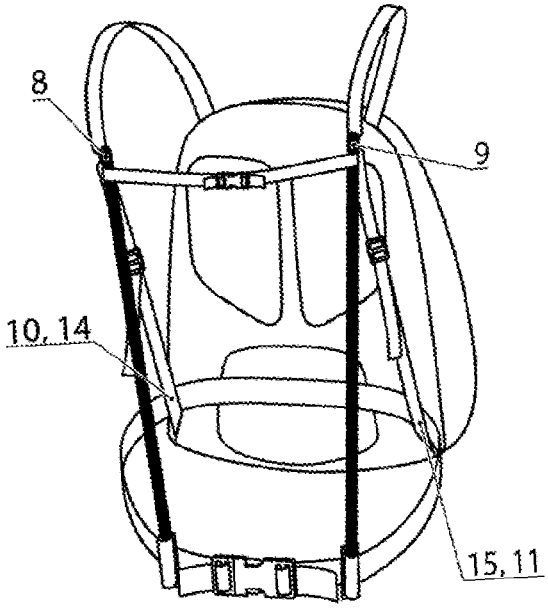


Fig. 55

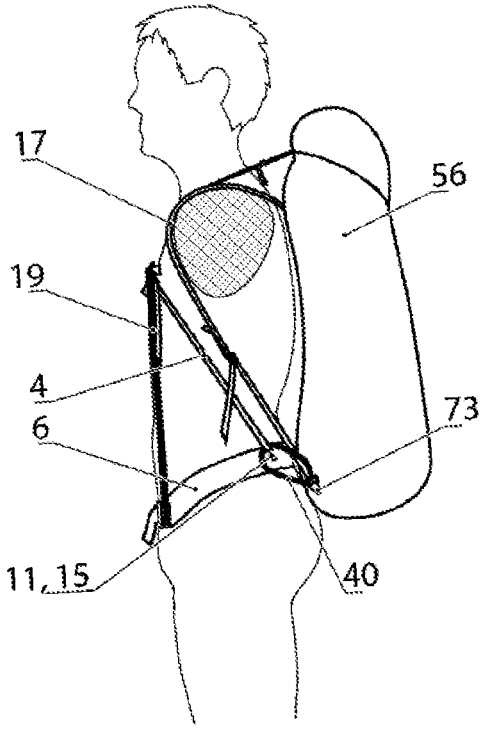


Fig. 56

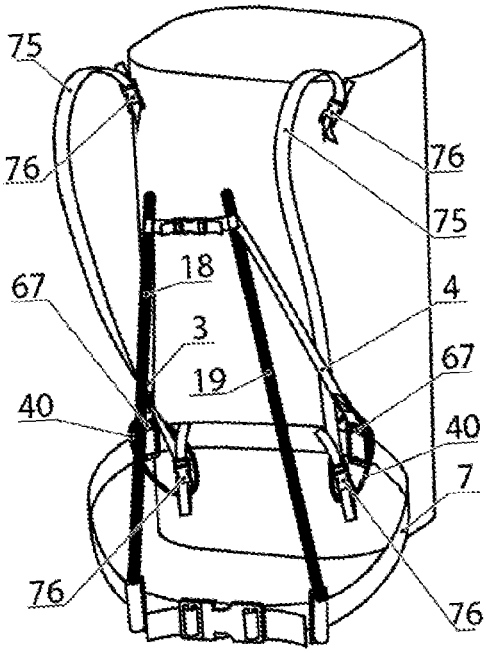


Fig. 57

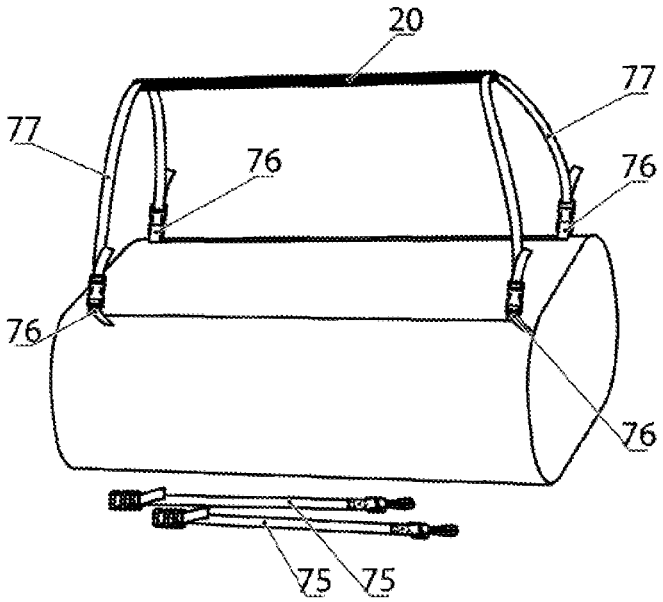


Fig. 58

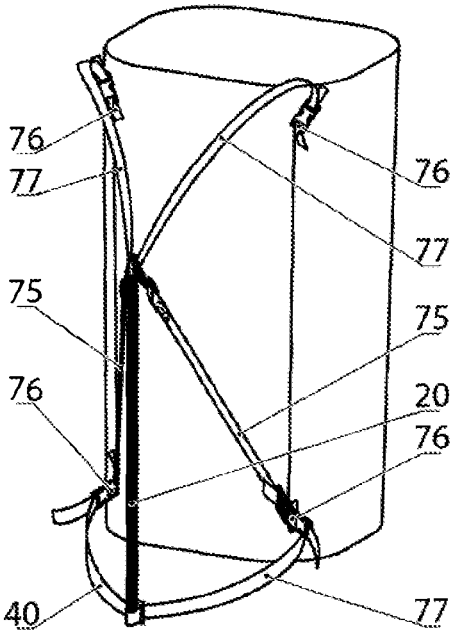


Fig. 59

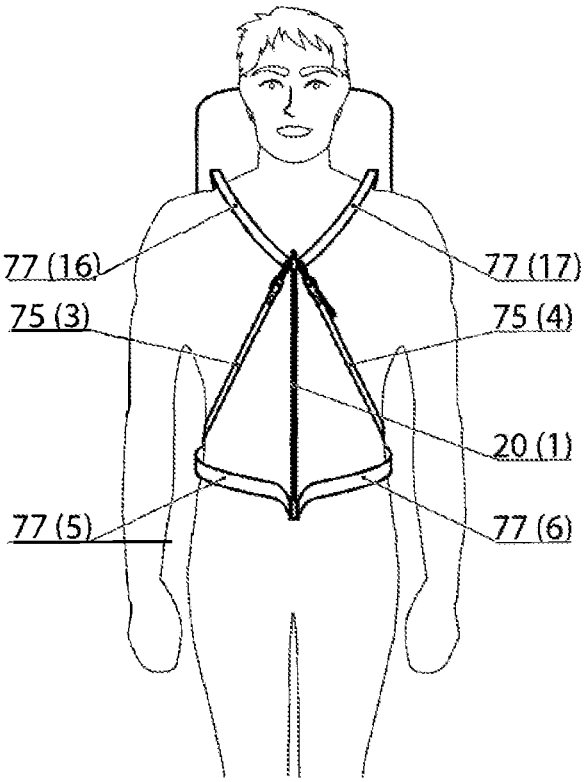


Fig. 60

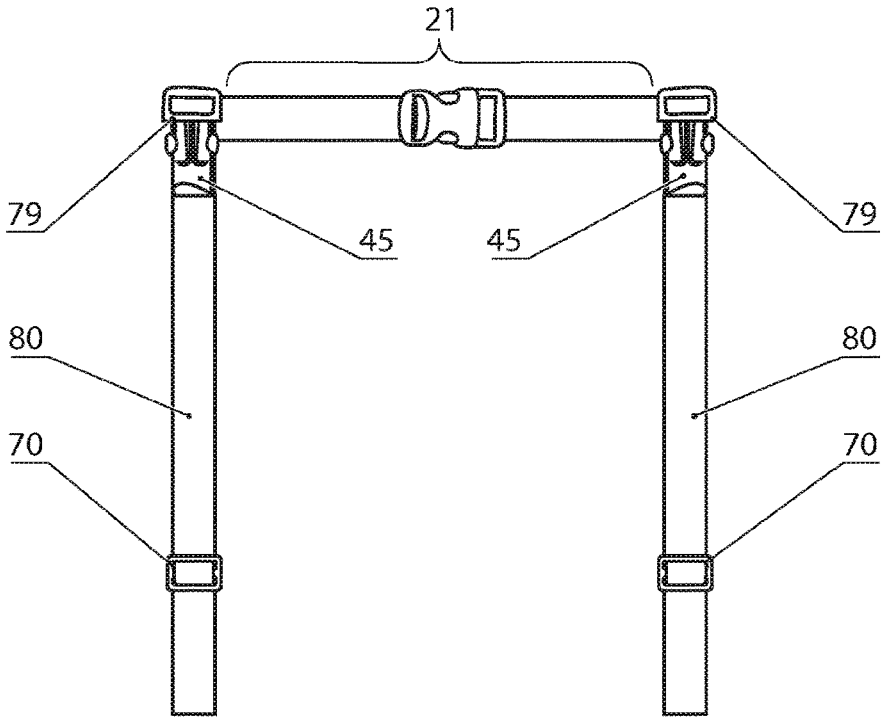
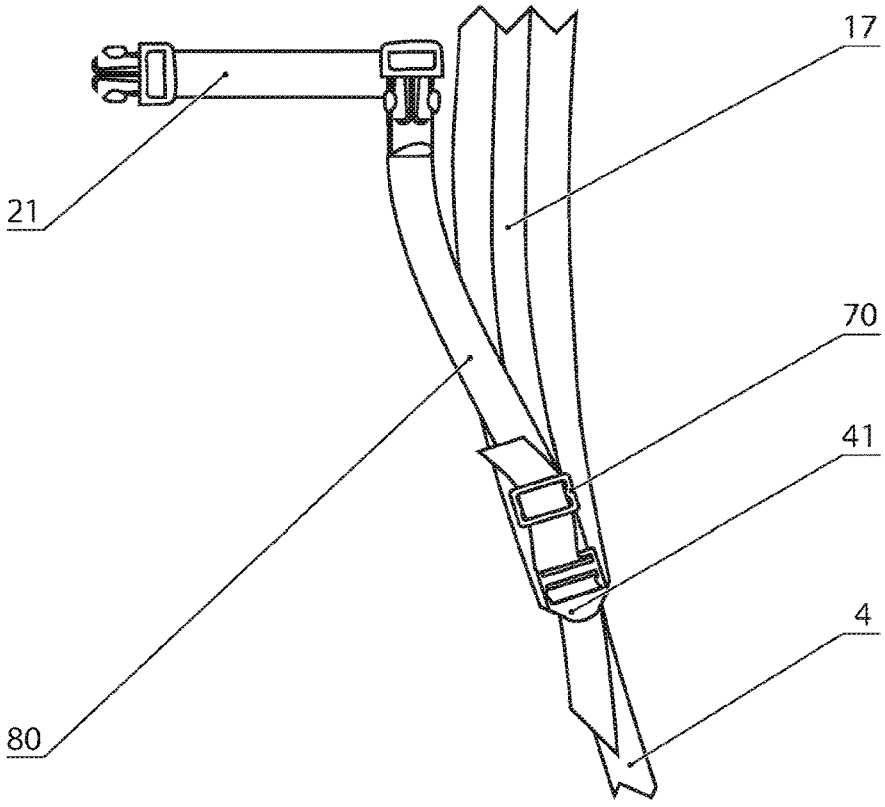


Fig. 61



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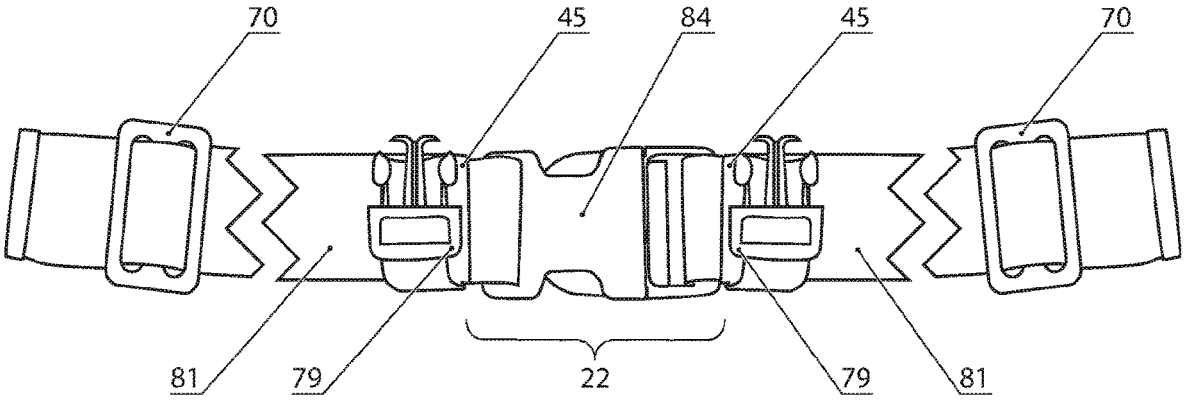

Fig. 63

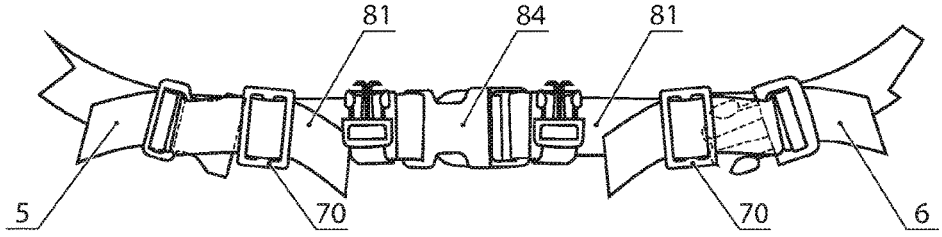

Fig. 64

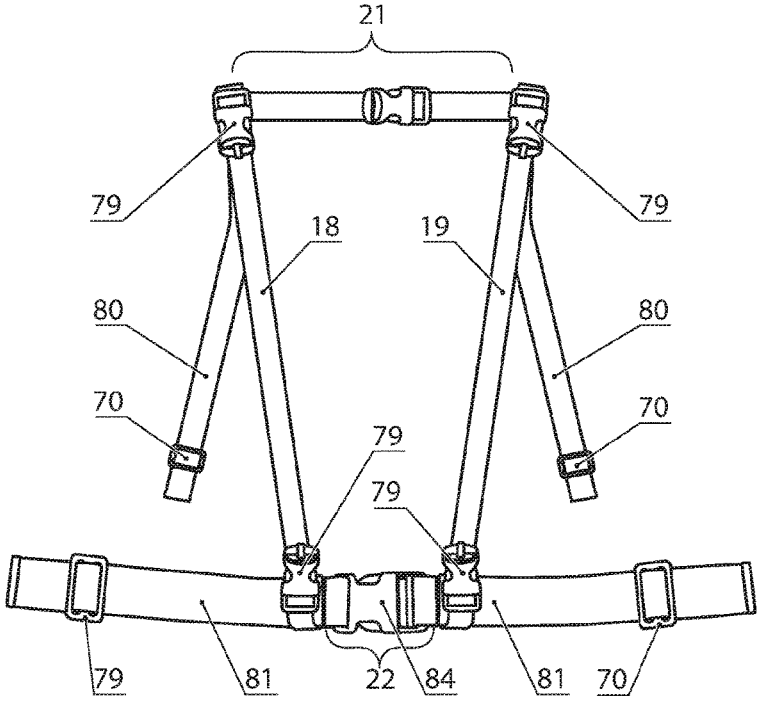

Fig. 65

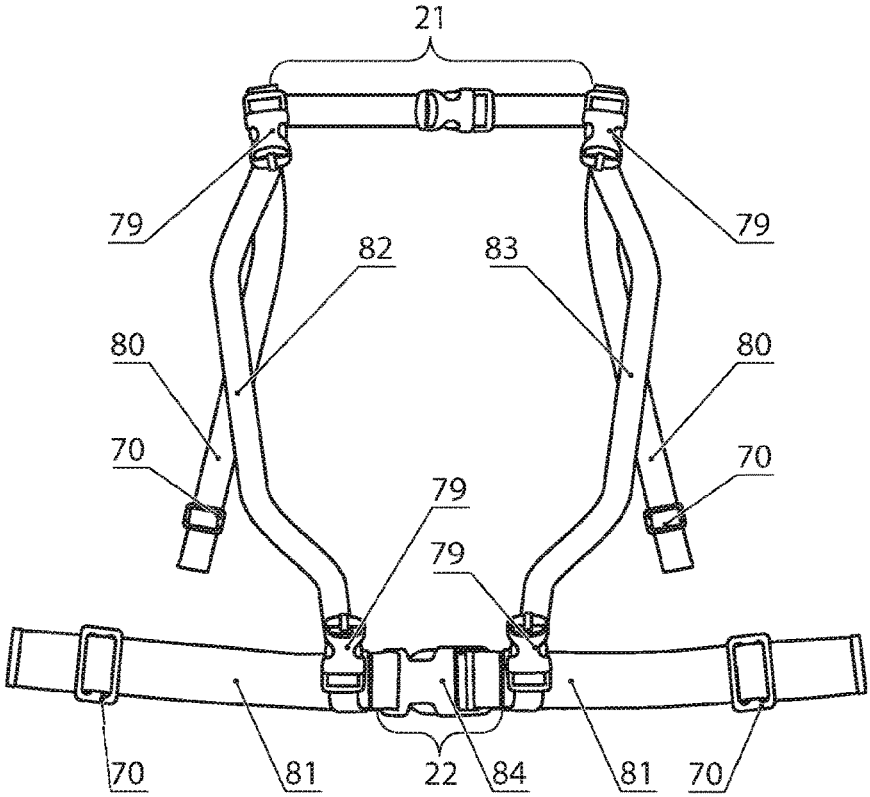

Fig. 66

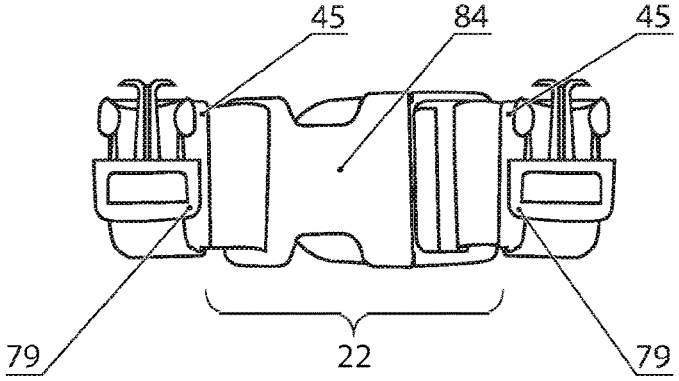

Fig. 67

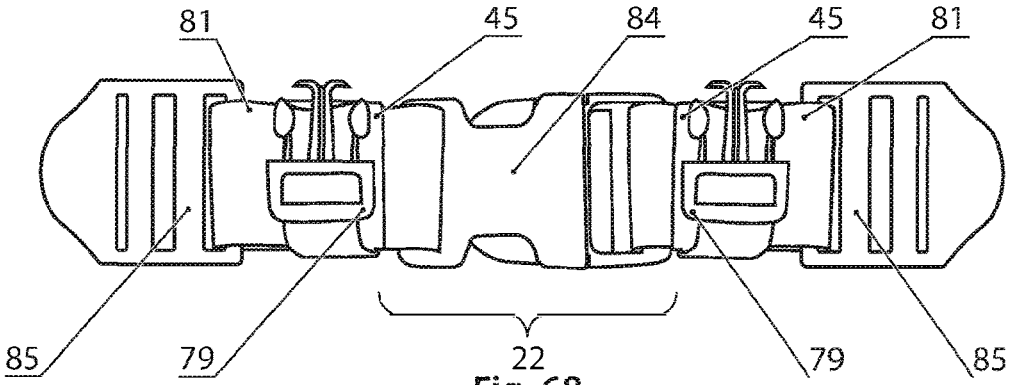

Fig. 68

LOAD-CARRYING DEVICE ATTACHED TO THE USER'S BODY, A SET FOR RETROFITTING SUCH A LOAD-CARRYING DEVICE, AND A METHOD FOR RETROFITTING SUCH A LOAD-CARRYING DEVICE

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation application of the International Patent Application No. PCT/PL2021/050024, filed Apr. 8, 2021, claiming priority of Polish Patent Application No. P. 433494, filed on Apr. 9, 2020 the contents of each of which are hereby incorporated by reference.

FIELD OF INVENTION

[0002] A load-carrying device attached to the user's body, a set for retrofitting such a load-carrying device, and a method for retrofitting such a load-carrying device.

BACKGROUND

[0003] The present invention relates to a load-carrying device attached to the user's body, a set for retrofitting such a load-carrying device, and a method for retrofitting such a device.

[0004] Load-carrying devices are personal devices intended to carry loads on the user's body. The load can be any object or person. The sum of the weight of the carrying device and the weight of the load represents the load that must be transferred to the user's body. The maximum amount of load that can be transferred to the user's body is hereinafter referred to as the loadability of the body. The carrying device transfers the load to the user's body in two areas: on the shoulders—with the help the shoulder straps and on the lumbar-iliac area—with the help the hip belt. Putting weight on the lumbosacral region is more favorable than putting weight on the shoulders. Placing weight on the arms puts stress on the shoulder girdle and spine, which radically limits the use of load-bearing devices for many users. In the existing solutions, the amount of load transferred to the lumbar and hip area is significantly lower than the loads that the user's body could bear (assume) in these areas. Consequently, a significant percentage of the load continues to be transferred to the shoulders and spine, with all its negative effects on the user. In known carrying devices a hip belt is used to transfer the load to the lumbosacral region of the user. Examples of such solutions are disclosed in the publications: U.S. Pat. No. 3,831,827, WO98/25499, WO2013/155065, U.S. Pat. No. 9,185,964B2, U.S. Pat. Nos. 4,480,775, 8,353,434, US2004/0065704, US2009/0090754. The known solutions do not fully use the loadability of the hip and lumbar areas and do not allow the arms to be fully relieved. The reason for this situation lies in the limitation of the applicable tightening of the hip belt, difficulties in giving it a fixed position (course), as well as difficulties in maintaining the stability of the position of the hip belt over time. On the user's torso, the area with the greatest tolerance to the pressure of the hip belt is located in the lower back, in the sacral area (regio sacralis). On the front, abdominal side of the user's torso, the lower areas are more tolerant to the pressure of the hip belt than the higher areas. This leads to the conclusion that the hip belt should be positioned significantly higher on the rear side and lower on the front side of the user's body. Consequently, when viewed from the side, it should occupy an oblique position. Due to the individual anatomical differences between users, the carrying device should allow each user to individually adjust the front and rear hip belt position to different heights. It is important that once set, the positions of the front and rear parts of the hip belt (and consequently also the distance between them) stay stable during use, Most of the carrying devices used including: backpacks (U.S. Pat. No. 3,831,827 WO98/25499), carrying vests (WO2013/155065, U.S. Pat. No. 9,185,964B2), frontpacks (U.S. Pat. Nos. 4,480,775, 8,353,434), child carriers (US2004/0065704), board carriers (US2009/0090754) are provided with a hip belt which runs substantially horizontally around the ventral part of the body. Such a design means that the applicable pressure force of the lumbar brace depends on the user's tolerance to pressure on the abdominal side. The lower tolerance to pressure on the abdominal side makes it impossible to apply on this side such a pressure that is possible on the lumbar side. Poor tightening of the hip belt in combination with the elasticity of the user's abdominal wall not only cause low loadability, but also instability in the position of the belt. For anatomical reasons, for most people it is impossible to achieve a fixed position (course) of the hip belt depending only on its length. One belt length may correspond to the range of possible positions. Likewise, the position of the belt is not dictated by its length—the user may place the belt in a specific position and then change its length, e.g. by tightening/loosening it. Therefore, even small body movements or load displacements may cause changes in the position (course) of the belt. As a result, the user has to correct the position of the belt during the walk. Attempts to stabilize the course of the belt by moving the belt's load points to the hips (U.S. Pat. No. 3,831,827) or by multiplying the number of places where the belt connects to a rigid or semi-rigid frame (WO98/25499) give half-way results, because they only partially stabilize the belt course, not allowing it to increase its tightening or the pressure performed by the belt. The greatest limitation of the hitherto (essentially horizontal) hip belts is as follows: it is not possible for a flaccid hip belt (as well as any other flaccid object) to transfer forces in a direction perpendicular to its length. The existing solutions aimed at increasing the transverse stiffness of the hip belt have little effectiveness.

SUMMARY

[0005] The object of the invention is to increase the mass of a load that can be carried by a user with a carrying device.

[0006] This aim is achieved by the device according to the invention mounted on the user's body, characterized in that:

[0007] includes front brace, lumbar brace; right under-shoulder strap; left under-shoulder strap, left hip strap and right hip strap; which are interconnected;

[0008] the front brace has attachment points for the front ends of the right under-shoulder strap, left under-shoulder strap, right hip strap and left hip strap;

[0009] the lumbar brace has attachment points for the rear ends of the right under shoulder strap, the left under-shoulder strap; the right hip strap and the left hip strap;

[0010] the attachment points for the under-shoulder straps to the front brace are located above the attachment points for the hip straps to this brace;

[0011] the attachment points for the under-shoulder straps to the front brace are located above the attachment points for these straps to the lumbar brace;

[0012] the attachment points for the hip straps to the front brace are located below the attachment points for the hip straps to the lumbar brace;

[0013] the distance between the points of attachment of the under-shoulder straps to the front brace does not exceed a preset value;

[0014] the distance between the points for attaching the hip straps to the front brace does not exceed a preset value;

[0015] the distance between the point of attachment of the right under-shoulder strap to the front brace and the point of attachment of the right hip strap to the front brace is not less than a preset value;

[0016] the distance between the point of attachment of the left under-shoulder strap to the front brace and the point of attachment of the left hip strap to the front brace is not less than a preset value;

[0017] the hip straps, under-shoulder straps and the lumbar brace are not stretchable;

[0018] the under-shoulder straps contain elements for adjusting their length;

[0019] the points of attachment of the hip straps to the front brace are situated in the space bounded by vertical planes, parallel to the plane of symmetry of the user's body and tangent to the inner surfaces of the user's anterior superior iliac spines.

[0020] In one of variants of the device according to the invention, the front brace has the form of two elongated rigid struts connected to each other by an upper and lower horizontal connector made of inextensible tape and provided with means for adjusting its length. The lower connector connects the lower ends of the struts and the upper connector connects the struts above the attachment points of the under-shoulder straps to the lumbar brace. The attachment points of the front brace to the hip straps and under shoulder straps are placed on the struts.

[0021] In another variant of the device according to the invention, the hip straps or the lumbar brace contain elements for adjusting their length.

[0022] In a further variant of the device according to the invention, the elements for adjusting the length of the connectors or the hip straps or the lumbar brace are removable.

[0023] In a further variant of the device according to the invention, the front brace has the form of a rigid frame or plate.

[0024] In a further variant of the device according to the invention, the struts are in the form of rods, advantageously hollow.

[0025] In a further variant of the device according to the invention, the struts have the form of flat bars.

[0026] In a further variant of the device according to the invention, each strut is made of a pair of telescopically connected tubes provided with a mechanism of blocking their sliding relative to each other.

[0027] In a further variant of the device according to the invention, the attachment point of the under-shoulder strap to the front brace has the form of a downwardly open pocket located on the under-shoulder strap, while the strut is provided with means to prevent it from slipping out of the pocket spontaneously.

[0028] In a further variant of the device according to the invention, the attachment point of the under-shoulder strap to the front brace is a tie connecting the strut with the under shoulder strap.

[0029] In a further variant of the device according to the invention, the attachment point of the hip strap to the front brace has the form of an upwardly open pocket, located on the hip strap, while the strut is provided with means to prevent it from slipping out of the pocket spontaneously.

[0030] In a further variant of the device according to the invention, the point for attaching the hip strap to the front brace has the form of a buckle connected to the lower end of the strut, while the hip strap is threaded through this buckle.

[0031] In another variant of the device according to the invention, the connection between the buckle and the strut has the form of a tie.

[0032] In yet another variant of the device according to the invention, the tie is a plastic zip tie strap or a braided band or a cord.

[0033] The invention allows for the retrofitting of known load carrying devices mounted on the user's body with sets according to the invention.

[0034] One of the retrofitting sets according to the invention consists of two length-adjustable, non-stretchable under-shoulder straps at both ends provided with means for connecting to a carrying device. The modernization of the known device with this set is carried out in the following way: The left and right length-adjustable non-stretchable under-shoulder straps are attached with their upper ends to the upper part of the carrying device and with the lower ends to the hip belt on the rear side of the body.

[0035] Another retrofitting set according to the invention consists of two elongated rigid struts having at both ends means for connecting them to the carrying device. Upgrading the known device with this set is carried out in the following way: The left and right elongated rigid struts are attached with their upper ends to the middle parts of the left and right shoulder straps, while their lower ends are attached to the hip belt on the front side of the user's body.

[0036] Yet another retrofitting set according to the invention consists of two elongated rigid struts and a hip belt, the lower ends of the struts being connected to the hip belt, the upper ends of the struts having means for connecting them to the carrying device. Upgrading a known device with this set is carried out in the following way: The left and right elongated rigid struts are attached with their upper ends to the middle of the left and right shoulder straps, and the hip belt is positioned between the shoulder straps and the load-carrying device.

[0037] Yet another method of modernization according to the invention consists in using a device according to the invention, in which the front brace has the form of two elongated rigid struts connected with each other by an upper and a lower horizontal connector made of non-stretchable tape and provided with means for adjusting its length, while the upper the ends of the under-shoulder straps of the modernized device are connected to the lower ends of the shoulder straps by means of a tie.

[0038] It has surprisingly been found that the invention has the following advantages:

[0039] 1. Design simplicity—the invention can be used in different designs with minimal modifications.

[0040] 2. Constructive compatibility with existing load-carrying devices. Known load-carrying devices can achieve the functional features according to the present invention after an uncomplicated modernization. The retrofitting is reversible. Known load-carrying devices have in their construction elements that can be used, either directly or after simple adaptation, as components of the present invention.

[0041] 3. Low production costs of the invention.

[0042] Possibility of self-assembly and disassembly. Elements modernizing the load carrying device to the standard of the invention can be incorporated into the structure of the load-carrying device by the user himself/herself in the field, without workshop requirements. Similarly, removing the modernization elements and recto ring the functionality of the load-carrying device to the state before the modernization is possible in the field. This applies both to modernization introduced by oneself and at the industrial production stage.

[0043] Possibility of using the invention conditionally, i.e. adding the set as needed and disconnecting it when the need ceases. Disconnecting the set does not diminish the functionality of the carrying device as compared to its state before disconnection.

[0044] Possibility of retrofitting with minimal resources, e.g. just by adding a pair of struts, or just by adding a pair of straps.

[0045] Contrary to the previous constructions, the invention does not require a stiffened and heavy hip belt to work effectively, and it will work with both a flaccid and a stiff hip belt.

[0046] Contrary to the known constructions, the invention does not require wide shoulder straps provided with a shock-absorbing layer, it will work with flaccid, thin straps. Low weight—the simplest retrofitting set consisting of two struts increases the weight of the backpack only by less than 100 g.

[0047] Comfort of use, consisting in the possibility of complete release of the load from the user's shoulders and spine.

[0048] The length of the shoulder straps is sufficient to adjust the distance of the backpack from the user's back in a wide range, which in turn is an effective and cost-free way of back ventilation. In known solutions, ventilation is achieved by appropriate structures placed on the surface of the backpack, which increase its weight and price. The possibility of using a hip belt by people with an untypical body shape. The existing constructions do not fulfill their load-carrying role in case of user's whose waist circumference is greater than their circumference in the hips. The use of the set according to the invention allows to transfer the load if only locally on the loins or hips there are positively sloped surfaces sloped surfaces to support the hip belt. Enabling people with pressure-sensitive abdominal areas to transfer the carried load to their lumbar or iliac area, thanks to the fact that the possibility of positioning or shaping the front brace makes it possible to avoid pressure, even accidental, onto the higher parts of the lower abdomen.

[0049] 14. Possibility of using carrying devices, especially backpacks, by people with spine and shoulder girdle dysfunctions, thanks to the transfer of the entire load to the hip belt, while the shoulder straps only retain their positioning function.

[0050] 15. Possibility of using carrying devices, especially backpacks, by people with unilateral dysfunctions in their upper torso and shoulder areas, e.g. with hypersensitivity to pressure after mastectomy, unilateral shoulder injuries. It is possible to connect two struts asymmetrically with one shoulder strap. The assembly of such a connection is easy even in the field, e.g. in the event of a sudden injury.

[0051] 16. High tolerance for changes in front-to-back load distribution over a wide range of loads without adjusting the tension of the tensioning straps or hip belt. Without removing the backpack or adjusting the tension of the straps, it is possible to attach and detach bags with equipment, purchases, etc., to the front brace.

[0052] 17. High tolerance for changes in front-to-back load distribution in a wide range of loads without adjusting the tension of the tensioning straps or the hip belt allows the invention to be used in load-carrying devices with strongly variable weight on each side, e.g. portable sprayers, where the load changes during operation as the tanks are emptied.

[0053] 18. Possibility to put the hands on the struts during a long walk with a backpack.

[0054] Backpackers feel a strong need to support their hands and most often they tighten their hands on the shoulder straps, increasing the pressure on their shoulder. Leaning or clamping the hands on the front brace does not increase the pressure on the shoulder straps and additionally reduces the load on the spine.

[0055] 19. The ability to optimize the load distribution between the front and back sides of the body allows the user to avoid moving in an unnatural tilt of the spine and the whole body.

[0056] 20. Possibility to design visually attractive carrying devices.

[0057] 21. The ability to attach many useful devices (e.g. flashlight, camera, telephone, GPS, trays, liquids containers, etc.) to the front brace within the user's reach: Selected devices can be easily operated while walking, without removing the carrying device.

[0058] 22. The possibility of carrying backpacks of various sizes interchangeably on the back and front side of the body, which is beneficial for the work of the spine.

BRIEF DESCRIPTION OF THE DRAWINGS

[0059] Embodiments of the invention are detailed below and shown in the accompanying figures.

[0060] FIGS. **1**, **2** and **3** show the assembly for managing the positioning of the lumbar brace and the pressure exerted on the body by the lumbar brace.

[0061] FIG. **4** illustrates anatomical indications for the location of the attachment points for the hip straps to the front brace.

[0062] FIG. **5** shows a comparison of the position of the straps in the hip region in the present invention and in existing solutions.

[0063] FIG. **6** shows an example of a front brace in the form of a rectangular frame.

[0064] FIG. **7** illustrates an example of a front brace in the form of a frame with curved sides.

[0065] FIG. **8** shows an example of a front brace in the form of an articulated frame.

[0066] FIG. **9** shows a front brace in the form of a 2T-frame.

[0067] FIG. **10** shows an example of a front brace composed of two telescopic struts.

[0068] FIG. **11** shows an example of a front brace composed of two bent struts.

[0069] FIG. **12** shows the front brace **1** reduced to a single strut.

[0070] FIG. **13** shows an example of a lumbar brace in the form of a belt of material stretched over the lower part of a rear frame.

[0071] FIG. **14** shows an example of a base harness based on the structure of the front brace from FIG. **1** to FIG. **3**.

[0072] FIG. **15**, FIG. **16**, FIG. **17** and FIG. **18** show different solutions for connecting the strut with the under-shoulder strap.

[0073] FIG. **19** shows the connection of the strut to the hip strap by means of a pocket.

[0074] FIG. **20**, FIG. **21** and FIG. **22** show different views of the connection of the strut with the hip strap by means of a buckle.

[0075] FIG. **23** shows a shaped zip tie.

[0076] FIG. **24** shows the connection of the strut with both the under-shoulder strap and the hip strap at the same time.

[0077] FIG. **25** shows how to attach n extra weight to the front brace.

[0078] FIG. **26** shows the connection of the strut with the hip strap and the upper connector.

[0079] FIG. **27** shows an articulation hinge.

[0080] FIG. **28**, FIG. **29** and FIG. **30** show a device for carrying asymmetrically placed loads.

[0081] FIG. **31** shows a device for carrying loads on the front and rear sides of the user body simultaneously.

[0082] FIG. **32** shows a set for carrying fluid reservoirs on the front and rear sides of the user body simultaneously.

[0083] FIG. **33** shows a carrying set with struts and a L-shaped rear frame.

[0084] FIG. **34** and FIG. **35** show a set for carrying backpacks on the front and rear sides of the user's body.

[0085] FIG. **36**, FIG. **37** and FIG. **38** show different designs of the front brace of a carrying device with one shoulder strap.

[0086] FIG. **39** shows a child carrier.

[0087] FIG. **40**, FIG. **42** show an infant carrier and FIG. **43** and FIG. **44** show constructional details of this carrier.

[0088] FIG. **45** shows an infant carrier with flat bar struts.

[0089] FIG. **46**, FIG. **47**, FIG. **48** and FIG. **49** show examples of retrofitting straps, and FIG. **50** and FIG. **51** show a backpack retrofitted with these straps.

[0090] FIG. **52** shows a retrofitting set consisting of two struts, and FIG. **53** shows a backpack retrofitted with this set.

[0091] FIG. **54** shows a retrofitting set consisting of two struts and a hip belt, while FIG. **55** shows a backpack retrofitted with this set.

[0092] FIG. **56** shows a rucksack retrofitted with the set presented on FIG. **1**, FIG. **2** and FIG. **3**, while FIG. **57** shows a luggage bag retrofitted with the same set.

[0093] FIG. **59** and FIG. **60** show a luggage bag with the possibility of changing the transport method by means of straps and a single strut.

[0094] FIG. **61** to FIG. **68** show the sets for retrofitting the load-carrying devices and parts of the sets.

[0095] FIG. **61** shows the top of the retrofitting set and FIG. **62** shows how this part is connected to the under-shoulder strap of the carrying device.

[0096] FIG. **63** shows the lower part of the retrofitting set and FIG. **64** shows how this part is connected to the hip straps of the carrying device.

[0097] FIG. **65** and FIG. **66** show sets or retrofitting the carrying device with struts of different shape.

[0098] FIG. **67** and FIG. **68** show the lower part of the retrofitting set alternative to that shown in FIG. **63**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0099] Embodiments of the invention are described in detail below with reference to the figures and using the following definitions:

[0100] Hip Belt

[0101] The hip belt is a so-called fragment of the carrying device that surrounds the lower part of the user's body with the possibility of being pressed against the body by adjusting the belt's length. A hip belt understood in this way can be both a uniform braided strap, as well as a chain composed of various rigid (e.g. buckles, plastic or metal parts of a container, parts of the frame) or flaccid (e.g. parts of the fabric of the backpack surface, strips of material stretched over the frame) elements. By naming the sections of the hip belt according to the parts of the human body to which they adjoin, we get the following sections: abdominal, lumbar, right hip and left hip. At least two of the sections mentioned in the previous sentence, i.e. the right hip and left hip section, are made of tape. Abdominal and lumbar sections can be an extension of the hip straps. They can also be fragments of other parts of the carrying device (e.g. frame, cargo container) and as such can be made of materials other than tape. The description of the present invention assumes the division of the hip belt into four parts, substantially similar to the above-mentioned belt sections. The abdominal section corresponds to the lower connector **22**, i.e. the fragment of the front brace **1** between the places of attachment to the right hip strap **5** and left hip strap **6**. The lumbar section corresponds to the lumbar brace **2**. The right hip section corresponds to the right hip strap **5**, and the left hip section corresponds to the left hip strap **6**.

[0102] The length of the hip belt can be adjusted by adjusting the length of the hip straps, the lumbar brace or the width of the lower part of the front brace.

[0103] Lumbar Brace

[0104] The part of the hip belt that is adjacent to the lumbar region of the user is referred to herein as the lumbar brace. In the simplest case, the lumbar brace is a piece of strap, often also a rigid or semi-rigid semi-hoop, or a part of the load housing (e.g. the wall of a backpack or container). The lumbar brace may consist of many parts constituting a functional whole, e.g. a tape stretched on a rear frame together with a fragment of that frame. The lumbar brace may be adjusted horizontally in length. The lumbar brace may consist of detachable parts. The lumbar brace clamps against the lumbar region of the user's body at a height lower than the height of the attachment **8**, **9** of the front ends of the under-shoulder straps to the front brace and at the same time higher than the height of the attachment **13**, **14** of the front ends of the hip straps to the front brace. Examples of a lumbar brace are shown in FIGS. **2**, **13**, **14**, **29**, **42** and **51**.

[0105] Front Brace

[0106] The front brace is an object adapted to be worn on the front side of the user's body, which has the possibility of attaching under-shoulder straps **3**, **4** and hip straps **5**, **6**. Examples of the front brace are shown in FIGS. **3**, **6**, **7**, **8**, **9**, **10**, **11**, **12**, **28**, **36**, **37**, **38**, **61** and **62**. The function of the front brace is to distribute the pressure on the front side of the user's body. The front brace can be used to attach a load.

The pressure distribution consists in shifting pressure points on the body from places of high sensitivity to areas of less sensitivity, and reducing local pressures by enlarging the pressure area (compared to a standard horizontal hip belt). In particular, the use of this brace allows the user to move the pressure away from the place of reduced resistance (locus minoris resistentiae), which is the navel located at the level of the waist. The areas of the user's body to which the attachment points **12**, **13** of the hip straps **5**, **6** to the front brace **1** may abut are shown in FIG. **4**. They are located on the lower abdomen of the user, below the waist level **24** and above the height of the pubic symphysis **30**, and within the area bounded by the inner surfaces of the upper anterior iliac spines **26**, **28**. An additional previously mentioned condition for the location of the places for fastening the straps **12**, **13**, **8**, **9** to the front brace **1** is the placement of the lumbar brace **2** at the height between the fastenings of the hip straps **12**, **13** and the under-shoulder straps **8**, **9**. Attachments of the tensioning straps to the front brace meet the conditions of vertical stiffness and horizontal inextensibility. The vertical stiffness condition means that the minimum distance L**3** between the attachment point of the front brace to the right under shoulder strap **8** and the right hip strap **12** is maintained, and the distance L**4** between the attachment point the front brace to the left under-shoulder strap **9** and the left hip strap **13** is maintained, respectively. Stiffness is to be sufficient to balance the compressive forces from the above straps. The condition of horizontal inextensibility means maintaining the maximum distance L**1** between the point of connection of the front brace to the right under-shoulder strap **8** and the left under-shoulder strap **9**, and the distance L**2** between the point of attachment to the brace of the front right hip strap **12** and the left hip strap **13**, respectively. In practice, the front brace will most often have the form of a pair of struts **18**, **19** connected by inextensible connectors **21**, **22**, or it will have the form of a flat or three-dimensional frame. Alternatively, the function of the front brace will be performed by the housing of an object (e.g. a backpack or a bag) worn on the front side of the body.

[0107] The front brace can be adapted to change the position of the places of attaching of the tensioning straps, e.g. by changing the length of the connectors or by changing the places of attaching the straps to the frame.

[0108] Right Hip Strap

[0109] The right hip strap is the fragment of the strap that runs along the right side of the user's body. The front end of the right hip strap is attached to the front brace and the rear end of the strap is attached to the lumbar brace. The right hip strap is part of the hip belt.

[0110] Left Hip Strap

[0111] The left hip strap is the fragment of the strap that runs along the left side of the user's body. The front end of the left hip strap is attached to the front brace and the rear end of the strap is attached to the lumbar brace. The left hip strap is part of the hip belt.

[0112] Right Under-Shoulder Strap

[0113] The right under-shoulder strap is the fragment of the strap that runs along the right side of the user's body. The front end of the right under-shoulder strap is attached to the middle or top fragment of the front brace, and the rear end of the strap is attached to the lumbar brace. The right under-shoulder strap is adjustable in length, it can consist of two parts connected with a releasable buckle.

[0114] Left Under-Shoulder Strap

[0115] The left under-shoulder strap is the fragment of the strap that runs along the left side of the user's body. The front end of the left under-shoulder strap is attached to the middle or top fragment of the front brace, and the rear end of the strap is attached to the lumbar brace. The left under-shoulder strap is adjustable in length, it can consist of two parts connected with a releasable buckle.

[0116] Tensioning Straps

[0117] Tensioning straps—this is the common name for the under-shoulder and hip straps.

[0118] By means of the tensioning straps **3**, **4**, **5**, **6**, the front brace **1** can be correctly connected to the lumbar brace **2**. The designer has the obvious choice between detachable and non-detachable tensioning straps. If the operation of placing or removing the load carrying device requires the temporary disconnection of the tensioning straps, then detachable straps must be used. Independence between the constructions of the front brace and the lumbar brace allows for a separate use of different versions of these braces.

[0119] Lower Connector

[0120] The lower connector is a chain of elements connecting the places of attachment of the hip straps to the front brace. In particular, the lower connector may be a section of a rigid element or a flexible non-stretchable tape. The lower connector may be removable by the user. The lower connector is a part of the hip belt.

[0121] Upper Connector

[0122] The upper connector is a chain of elements connecting the points of attachment of the shoulder straps to the front brace. In particular, the upper connector may be a section of a rigid element or a flexible non-stretchable tape. The top connector may be removable by the user.

[0123] Shoulder Straps

[0124] The shoulder straps in the existing solutions are used to transfer the weight to the user's shoulders and to position the load. The shoulder straps run from the bottom of the carrying device, pass under the arms to the opposite side of the body and return to the loaded carrying device over the shoulders. In the present invention, the shoulder straps serve to control the position of the load along the body, not to transfer the load to the shoulders. The shoulder straps are attached to the top of the front brace. In particular, it is possible to attach the shoulder straps to the front brace at the same locations as the under-shoulder straps. Consequently, the same strap below the attachment point to the front brace may function as a under-shoulder strap and above as a shoulder strap.

[0125] Strapping Tapes

[0126] Strapping tapes are used to fasten the load to the carrying device. One strapping tape may be attached to the carrying device at one, two or more points. The number of strapping tapes and how they are attached to the device depends on the carrying device and the carried load.

[0127] Assembly for Managing the Lumbar Brace Position

[0128] In order to achieve full loadability of the lumbar and iliac zones, the carrying device must provide the user with the possibility to choose the position of the lumbar brace, the stability of the position of the lumbar brace during use, as well as the possibility of adjusting the pressure of the lumbar brace against the body. The mentioned properties of the carrying device should be ensured regardless of the weight of the load and the setting of the pressure of the shoulder straps on the shoulders. In particular, it should be

possible to ensure that the entire load is transferred to the lumbar and iliac regions. The function of shoulder straps should be to control the position of the load along the body, not to transfer the load to the body. The aforementioned requirements are met by a carrying device, in which it is possible to functionally isolate an assembly for managing the positioning of the lumbar brace and the pressure exerted on the body by the lumbar brace, hereinafter referred to as the assembly. The assembly consists of the following parts: front brace **1**, lumbar brace **2**, right under-shoulder strap **3**, left under-shoulder strap **4**, right hip strap **5**, left hip strap **6**. Regardless of whether the load is attached to the lumbar brace or the front brace, it will be transferred to the flaccid tensioning straps which, at the point of connection with the brace, take a direction of high vertical component. If the load is attached to the front brace, it will be transferred to the flaccid hip straps. The hip straps at the point of connection with the front brace take a direction with a large vertical component. The load on the hip straps will be transferred partly, directly to the hips and partly through the lumbar brace to the user's lumbar region.

[0129] If the load is attached to the lumbar brace, it will be transferred to the flaccid under shoulder straps. The under-shoulder straps at the point of connection with the lumbar brace take a direction with a large vertical component. From the under-shoulder straps, the load will be transferred to the front brace and then to the hip straps as described above. Importantly, the shoulder straps are not involved in transmitting the load to the user's body in either of these two cases. The positioning of the assembly on the body is performed individually by the user, depending on his anatomy and preferences. The user has a considerable freedom in setting the length of the hip-straps and under shoulder straps and, consequently, the position of the braces. He can also easily adjust this position, which allows to systematically alternate pressure points on the body to avoid abrasions and blisters.

[0130] FIGS. **1**, **2** and **3** show the assembly for managing the lumbar brace **2** position and the pressure exerted on the body by the lumbar brace **2** in side, back and front views, respectively. The hip straps **5**, **6** and the under-shoulder straps **3**, **4** connect the lumbar brace **2** and the front brace **1**. The under-shoulder straps **3**, **4** run from the attachment points **10**, **11** to the lumbar brace **2** diagonally upwards to their attachment points **8**, **9** to the front brace **1**. The hip straps **5**, **6** run from the attachment points **14**, **15** to the lumbar brace **2** diagonally downwards to their attachment points **12**, **13** to the front brace **1**. For most of the embodiments shown (FIGS. **1-3**, **14**, **31**, **32**, **33**, **34**, **39**, **40**, **42**, **50**, **51**) the left under-shoulder strap **4** and the left hip strap **6** have a common attachment point **11**, **15** to the lumbar brace. **2**, as well as the right under-shoulder strap **3** and the right hip strap **5** share a common attachment point **10**, **14** to the lumbar brace **2**. There are also examples of separate attachment points for the under-shoulder straps **3**, **4** and the hip straps **5**, **6** to the lumbar brace (FIGS. **13**, **28**, **29**, **30**, **36**). The under-shoulder straps **3**, **4** are adjustable in length. Changing the length of the under-shoulder straps is easy and can be done by the user at any time. Simultaneously with the adjustment of the length of the under-shoulder straps **3**, **4** and the connectors **21**, the user adjusts the position of the lumbar brace **2** to his own anatomy and comfort, sets the position of the front brace **1**, and sets the forces with which both braces **1**, **2** act on the body. It is possible to attach the load to any element of the assembly: to the hip straps **5**,**6**, to the lumbar brace **2**, to the under-shoulder straps **3**, **4**, and to the front brace **1**.

[0131] FIG. **3** shows an example of a releasable front brace **1** consisting of two struts **18**, **19** connected by connectors: upper **21** and lower **22**. The struts **18**, **19** are made of plastic pipes. Connectors **21**, **22** are made of braided tape, provided with releasable buckles which allow to adjust the connector length. The connectors **21**, **22** provide the possibility of adjusting the width of the front brace **1** as well as the angle between the struts **18**, **19**. FIG. **4** illustrates anatomical indications for the location of the attachment points for the hip straps to the front brace. The points of attachment of the hip straps to the front brace are above the horizontal plane **30** passing through the pubic symphysis **29** of the user, and in the space bounded by vertical planes **26**, **28** tangent to the inner surfaces of the upper anterior iliac spines **25**, **27** of the user, as well as below the level **24** of the navel **23**.

[0132] FIG. **5** shows a comparison of the course of the straps in the hip region in the present invention and in known designs. The previously known design solution is drawn with a dotted line, and the solution according to the invention is drawn with a continuous line. The horizontal course of the hip belt in known constructions limits the possibility of transferring vertical loads, and its course at the height close to the navel prevents the application of high tension force of the hip belt. In the present invention, the vertical loads are transferred from the carried load to the under-shoulder straps and the hip straps, in places where the directions of these straps have a significant vertical component.

[0133] FIG. **6** shows an example of the front brace **1** in the form of a rectangular frame **34** in a front view. On the sides of the frame **34** there are holes for attaching the tensioning straps, shoulder straps and strapping tapes. Holes for straps, in particular strapping tapes, can be drilled by the user anywhere in the frame **34**, also for fastening a specific load. Any number of strapping tapes as required may be attached to the frame **34**. The hip straps **5**, **6** are attached to the holes in the lower horizontal part of the frame **34**. The under-shoulder straps **3**, **4** are attached to the holes in the upper fragments of the vertical parts of the frame **34**. Users with different anatomical structures can choose convenient places for fastening the tensioning straps from among the prepared holes in the frame **34**.

[0134] FIG. **7** illustrates an example of a front brace **1** in the form of a frame with curved sides when viewed from the front. The intersection of the under-shoulder straps **3**, **4** with the hip straps **5**, **6** is possible when the attachment points of the under-shoulder straps to the lumbar brace **2** are below the hip strap attachments to this brace (FIGS. **13** and **30**).

[0135] FIG. **8** shows a front view of an example of a front brace in the form of an articulated frame with bent sides **18**, **19**, with its lower edge (connector) **22** connected to the sides **18**, **19** by means of hinges **31**. The sides **18**, **19** of this frame are movably connected by the connector **22** meet the function of struts. The distance between the sides **18**, **19** can be adjusted. The upper connector **21** is made of a braided band provided with a length

adjuster. The length of the lower connector **22** can be changed stepwise by moving the hinges **31**. The structure of the hinge **31** is shown in FIG. **27**.

[0136] FIG. **9** shows the front brace **1** in the form of a 2T-frame as an example of design possibilities for creating new designs of load-carrying devices.

[0137] FIG. **10** shows an example of a front brace **1** composed of two struts **18**, **19** connected by releasable connectors: upper **21** and lower **22**. Struts have a telescopic structure with the possibility of changing their length and are provided with a slide lock **32**. In the lower part, each strut **18**, **19** is covered with a covering foam **33**, improving comfort for hands when they are clenched on the strut. In the upper part of the struts **18**, **19**, various items, e.g. a camera or a flashlight **53**, can be easily attached.

[0138] FIG. **11** shows an example of a front brace composed of two curved struts **18**, **19**. Struts of various shapes may be used to suit the individual anatomy of the user.

[0139] FIG. **12** shows the front brace **1** reduced to a single strut **20**. The strut **20** has a ball attached at its upper end to prevent the potential effect of hitting the body. The buckles adjusting the length of the under-shoulder straps and the hip straps on one side are releasable to allow the carrying device to be placed on the body from the side. An example of a carrying device according to the invention with a single strut is shown in FIGS. **59** and **60**.

[0140] FIG. **13** shows an example of a lumbar brace **2** in the form of a material belt **36** stretched over the lower part of the rear frame **35**. The under-shoulder straps **3**, **4** and the hip straps **5**,**6** are attached to the holes in the frame **35**. Attachment points **10**, **11** for the under-shoulder straps **3**, **4** are located below the attachment points **14**, **15** of the hip straps **5**, **6**. The user can change the places where the tensioning straps are attached to the lumbar brace and, for example, attach the under-shoulder straps and the hip straps at the same point. Two strips of material **36** are stretched on the vertical sides of the rear frame to distribute the pressure forces over the back; the lower belt together with the lower part of the frame **35** functions as a lumbar brace **2**. The lumbar brace **2** is surrounded by a dashed line.

[0141] FIG. **14** shows an example of a base harness based on the structure of the front brace of FIGS. **1**-**3**. In FIG. **12**, the dashed line surrounds the lumbar brace **2**. In the case of the base harness of FIG. **14**, the loads can be attached to the lumbar brace **2**, or to the front brace **1**, or to the shoulder straps **16**, **17**.

[0142] FIG. **15** shows the connection of the strut **20** to the under-shoulder strap **3**, **4** by means of a plastic zip tie **40** in a front brace with struts (FIGS. **1**, **3**, **5**, **10**, **11**, **12**, **14**, **33**, **34**, **35**, **37**, **38**, **39**, **53**, **55**). A piece of an outer tape **37** is sewn onto the under-shoulder strap **3**, **4** by at least three transverse seams **38**, forming an upper and lower loop. In the side

surface of the strut **20**, at a distance of 20-30 mm from its upper end, there are a pair of coaxial holes **39**. The diameters of these holes allow for the passage of the zip tie **40**. The zip tie **40** has two loops, which are passed through the upper and lower loops of the outer tape **37** and twice through the holes **39** in the strut **20**. Pulling and locking the zip tie **40** will permanently align the strut holes at the center seam **38**. Whenever a plastic zip tie **40** is used in this and other drawings, it may be replaced with a braided band up to 10 mm wide, or a rope. The connections shown in FIGS. **15**, **16**, **17**, **18**, **19** may be used alternatively in applications of the invention.

[0143] FIG. **16** shows the application of the connection of FIG. **15** when there are no loops of an outer tape **37** at the height of the openings **39** in the strut **20** and there is an adjusting self tightening buckle **41** at the distance accessible to the zip tie **40**. The buckle **41** is connected to the loop **42**. The zip tie **40** has two loops: the upper one embraces the strap **16**, **17**, and the lower one stretches the under-shoulder strap **3**, **4** through the loop **42**.

[0144] FIG. **17** shows another version of the solution of FIG. **16** in a situation where the lower loop of the zip tie **40** needs to be extended. For this extension, a strap loop **43** closed with a self-tightening buckle **44** is used. The loop **43** is also led through a self-tightening buckle **41**.

[0145] FIG. **18** shows the connection of the strut **20** to the under-shoulder strap by means of a zip tie **40** and a pocket **45**. The pocket **45** is sewn onto the under-shoulder strap **3**, **4** with its opening directed downwards of the strap **3**, **4**. In the side surface of the strut **20**, a bit apart from the upper end greater than the depth of the pocket **45**, there is a pair of coaxial holes **39**, the diameters of which allow for the passage of the zip tie **40**. There are openings **46** in the upper corners of the pocket **45** to allow the zip tie **40** to be led through. The zip tie **40** is guided through the holes in the strut **39** and through the opened corners of the pocket **46**. The zip tie is accessible from the outside along the length of the pocket, which allows its function to be extended to transport items suspended thereon.

[0146] FIG. **19** shows the connection of the strut **20** to the hip strap **5**, **6** by means of a zip tie **40** and a pocket **45** analogous to the connection to the under-shoulder strap of FIG. **18**. A pocket **45** is sewn onto the hip strap **5**,**6** with an opening directed upward across the strap **5**,**6**. Holes **46** are provided at the lower corners of the pocket **45** to allow the zip tie **40** to pass through. The zip tie **40** is passed through holes **39** in the strut and holes **46** in the corners of the pocket **45**. Vertical fragments of the zip tie **40** extend inside the pocket **45**. FIG. **20** shows a front view of the strut **20** attached to the hip strap **5**, **6** by means of a zip tie **40** and a single-hole buckle **48**. The hip strap **5**, **6**, when passed through the hole of the buckle **48**, forms a loop surrounding the lower end of the strut **20**. The zip tie **40**

tightens the buckle **48** to the strut and prevents movements of the hip strap **5**,**6** relative to the strut **20**. The excess length of the zip tie **40**, useful in mounting and dismounting this connection, may be inserted into the strut **20**.

[0147] The method of attaching a hip strap **5**,**6** to a strut **20** using a single-hole buckle **48** and a zip tie **40** as shown in FIG. **20**, FIG. **21** and FIG. **22**, can be used to connect **20** different buckles to the strut, including buckles that do not require the hip strap to be wrapped around the strut **20**.

[0148] FIG. **21** shows the rear view of the same fastening as shown in the front view in FIG. **20**. FIG. **22** shows a cross-sectional view of the connection of a single-hole buckle **48** to a strut **20** by means of a zip tie **40**. The zip tie **40** is inserted into the strut and led out through the opening **47**. After being wrapped around the upper short side of the buckle **48**, it is re-inserted into the opening **47**, then wrapped around the lower short side of the buckle **48** and locked by latch lock of the zip tie **40**. An excess length of the zip tie useful for tightening and opening the zip tie **40** may be inserted inside the strut.

[0149] FIG. **23** shows a zip tie **40** which is permanently thermoformed to facilitate the attachment of the buckle **48** (from FIG. **22**) to the strut **20** and to improve the durability of this attachment. Where the zip tie in FIG. **22** surrounds the upper and lower sides of the single-hole buckle **48**, it is

permanently bent with a radius of curvature corresponding to the shape of the side of the buckle.

[0150] FIG. **24** shows the connection of the strut **20** to the under-shoulder strap **3**,**4** by means of a pocket **45** and to the hip strap **5**,**6** by means of a pocket **45** as well as the connection of both pockets by a cord **49** led inside the strut **20**. The cord **49** prevents the pockets **45** from slipping from the ends of the strut **20**.

[0151] FIG. **25** shows how to attach additional load to the front brace by means of the two outer tape loops **37** shown in FIG. **15**. Here the load is suspended, for example, by means of a carabiner **50** and a strap finished with a G-hook **66** (FIGS. **34**, **35**, **39** and **46**). It is also possible to suspend the loads on the end of the strut **20** protruding from the zip tie **40**, as well as to suspend it directly to the existing or additional loops formed by the zip tie **40**. Suspending the load on the front brace does not change the tension of the shoulder straps **16**, **17** nor the pressure of the load on the arms.

[0152] FIG. **26** shows the fastening of the under-shoulder strap **3**, **4** to the strut **20** by means of a zip tie **40** and a self-tightening buckle **41** regulating the length of the under-shoulder strap **3**, **4**. At the same time, the loop of the zip tie **40** stabilizes the connection of the upper connector **21** with the strut **20**. The connection is used according to the invention in carrying devices with one shoulder strap shown in FIG. **37** and FIG. **38**.

[0153] FIG. **27** shows the hinge **31** from the articulated frame of FIG. **8**, connecting the strut **19** with the lower connector **22**.

[0154] FIG. **28**, FIG. **29** and FIG. **30** show the carrying device according to the invention adapted to carry asymmetrically suspended loads, e.g. brushcutters, in front, back and side view, respectively. The device consists of the front brace **1** from FIG. **6** and the lumbar brace **2** from FIG. **13**. All straps shown here are provided with releasable buckles and can be adjusted in length. Thanks to the separability of the tapes allows to put on/take off the set. The shoulder straps **16**, **17** serve to control the position of the load along the body and not to transfer the load to the shoulders. The strapping tape **51** has one end attached to the front frame and the other end to the rear frame; it hangs down to hip level, where a tool hook, e.g. for a brushcutter, is attached to it.

[0155] FIG. **31** is a side view of the set adapted to carry loads on the front and rear sides of the user's body. The set consists of two L-shaped frames **52** facilitating the fastening of loads. The ability to evenly place loads on the front and back sides of the body allows the user to maintain a natural posture; even under heavy loads, and transferring the weight to the hips spares the user's shoulders and spine.

[0156] FIG. **32** shows a side view of a carrier set designed for two-sided transport of fluid tanks, e.g. a knapsack sprayer with an additional fluid reservoir attached to the front brace. Sprayers in which the wall of the tank is adjacent to the rear side of the user's body are in common use. The function of the lumbar brace **2** is performed by the lower part of the sprayer tank, outlined with a dashed line, pressed against the lumbar region by tensioning straps.

[0157] FIG. **33** shows a side view of a carrier assembly consisting of a standard rear frame **52** for the transport of loads, connected to the front brace **1** from FIG. **3**.

[0158] FIGS. **34** and **35** show a set for carrying backpacks **56** and **57** on the rear and front sides of the user's body in the front and side view; respectively. The method of FIG. **25** is used to attach a carry-on backpack **57** and a bottle **58** to the front brace. Suspending the loads **57** and **58** on the front brace does not alter the tension of the shoulder straps **16**, **17** nor their pressure on the shoulders, and improves the user's balance.

[0159] FIG. **36** shows the front brace from FIG. **28** used with one shoulder strap **17**. In many applications, one shoulder strap may suffice because the shoulder strap serves to hold loads along the body, that is, it carries horizontal loads, not vertical loads.

[0160] FIG. **37** shows the front brace **1** from FIG. **3** with one shoulder strap **17**. The right strut **18** is attached with an adjustment buckle to the upper connector **21** as shown in FIG. **26**. This solution can be used in field conditions and allows for quick adjustment of the backpack harness **56** in the event of a sudden injury to the shoulder joint area. The solution from FIG. **37** can also be used by users with permanent disabilities in the area of the shoulder girdle such as post-mastectomy conditions.

[0161] FIG. **38** shows a modification of the solution from FIG. **37** with the use of struts **18**,**19** of telescopically adjustable length.

[0162] FIG. **39** shows a child carrier **59** attached to the rear frame **35**. An additional weight may be attached to the front brace as shown in FIG. **34** and FIG. **35**.

[0163] FIG. **40**, FIG. **41** and FIG. **42** show an infant carrier suspended on struts **18**, **19** in a side, front and rear view, respectively. An infant carrier of a standard design is held against the user's body by a pair of shoulder straps **60** and a belly strap **61**. By adding a pair of struts **18**, **19**, under-shoulder straps **3**, **4** and hip straps **5**, **6** with a lower connector **22** it is possible to transfer most of the load to the lumbar brace **2**. The lower sections of the shoulder straps **60** and the waist strap **62**, the extension of which is the belly, strap **61**, are suspended from the struts **18**, **19**.

[0164] FIG. **43** shows how the load of the carrier of FIG. **41** is transferred to the strut **20** (**18**, **19**). The load from the lower section of the shoulder strap **60** is transferred through the pocket **45** to the upper end of the strut **20**. The load from the waist strap **62** is taken over by the loop **63** sewn on this strap. By means of a zip tie **40** threaded through the loop **63** and the hole **39** in the central part of the strut **20**, the strut takes the load over. The strut transmits the load to the hip strap **5**, **6** at the attachment point **12**, **13**. The under shoulder strap **4**, **5** (from FIG. **46**) ends with a G-hook at the upper end and a three-way buckle **67** at the lower end. The G-hook is attached to a loop **63** sewn to the pocket **45** in the shoulder strap **60**. A zip tie **40** is threaded through the same loop **63** to prevent the upper end of the strut **20** from sliding out of the pocket **45**. Unfastening the G-hook **66**, unfastening the zip ties **40**, and sliding off the 3-way buckle (**67**) allows the carrier to be brought back in to a commonly known form.

[0165] FIG. **44** shows the connection of the under-shoulder straps **4**, **5**, belly strap **61** and hip straps **5**, **6** by means of a three-way buckle **67** in the infant carriers from FIGS. **40**-**43** and **45**.

[0166] FIG. **45** shows the infant carrier from FIGS. **40**-**42**, in which the struts **18**, **19** have been replaced by flat bar struts **64** and the lower braided web connector **22** has been replaced by a flat bar connector **65**. The use of a flat bar improves the comfort of the infant as the struts a of the flat bar **64** are thinner and allow a thinner material of the waist strap **62** to be used.

[0167] Figures from FIG. **46** to FIG. **49** show examples of non-stretchable straps **78** of adjustable length. At the ends of each strap **78** there are means for attaching the straps to a backpack or bag. These straps **78** can be used as under-shoulder straps while adapting

the backpack **56** to be worn on the front of the user's body (FIG. **50** and FIG. **51**) as well as for adapting bags similarly (see FIGS. **59**, **60**). Retrofitting of both the backpack or the bag has the beneficial effect of transferring the load to the hips with minimization of the load pressure on shoulders. FIG. **46** shows a strap **78** with a three-way buckle **67** for attaching to the backpack' hip belt and a G-hook **66** for attaching to the top of the backpack. FIG. **47** shows a strap **78** with a three-way buckle with slots **68** for quick application onto the strap of the backpack's hip belt and a clip **69** for attaching it to the top of the backpack. FIG. **48** shows a strap **78** with a loop closed with a double-hole buckle **70** and a safety hook **71** for attaching to the top of the backpack.

[0168] FIG. **49** shows a strap **78** with a G-hook **66** and a safety hook **71**, designed for connecting the upper end of the strut to the hip strap while fitting a bag as shown in FIG. **59** and FIG. **60**.

[0169] FIG. **50** and FIG. **51** respectively show side and rear views of a backpack **56** retrofitted by adding the pair of straps from FIG. **46** as under-shoulder straps **3**, **4**, The purpose of this modernization is to allow to wear on the front of the body a backpack **56** originally intended to be worn on the back. In the modernized backpack placed on the front of the user's body, the wall of the backpack adjacent to the body serves as a front brace **1**. Such modernization of the backpack results in a reduction of the load on the shoulder straps **16**, **17** and a lowering of the backpack position on the body, which is important for visibility and allows for carrying in the front large backpacks, e.g. of a 40-60 liters capacity. In FIG. **50**, the strap **78** from FIG. **46** is attached with its upper end by means of a G-hook **66** to a known compression strap **74** located in the upper part of the back pack **56**. The hip belt of the backpack **56** is threaded through the buckle **67** located at the lower end of the strap **78**. The buckle **67** divides this hip belt into the right hip strap **5**, the lumbar brace **2**, and the left hip strap **6**.

[0170] FIG. **52** shows an example of a retrofitting set consisting of a pair of struts **18**, **19** with means for attaching their ends to the shoulder straps of the backpack and to a hip belt. A zip tie **40** is threaded through a hole **39** in the upper part of the strut to attach the strut to the under-shoulder strap, and a buckle **48** attached to the lower end of the strut is used to attach the strut to the hip strap. In detail, alternative methods for attaching the struts to the harness are illustrated in FIGS. **15** to **18**, and methods for attaching the struts to the hip belt are illustrated in FIG. **20**, FIG. **21** and FIG. **22**.

[0171] FIG. **53** shows a backpack provided with a hip belt retrofitted with the set from FIG. **52**. Each of the struts **18**, **19** is attached to the hip belt and to the shoulder strap. The fastening of the struts to the hip belt is shown in FIGS. **20**, FIG. **21** and FIG. **22**. The places for attaching the struts to the hip belt divide the hip belt into a right **5** and left **6** hip strap and the lower connector **22**. The struts are attached to the shoulder straps by tightening the zip ties **40** passing through the holes **39** in the struts and surrounding the strap. The combinations shown in FIGS. **15** to **18** are also possible. The function of the upper connector **21** is provided by the chest strap of the backpack, or an upper connector may additionally be attached to the upper end of the strut as shown in FIG. **26**.

[0172] FIG. **54** shows the retrofitting set resulting from combining the set of FIG. **52** with a hip belt shows a known backpack which, according to the invention, consists of a bag serving as a load carrying device connected to shoulder straps and a hip belt retrofitted with the set from FIG. **54**. The fastening of the struts to the shoulder straps at attachment points **8**, **9** is presented in the description of FIG. **53**. The hip belt **7** of this set is placed between the shoulder straps and the pall of the backpack bag.

[0173] FIG. **56** shows a side view of the use of the assembly of FIG. **1**, FIG. **2** and FIG. **3** to retrofit a known backpack **56**. The purpose of this retrofitting is to transfer the weight of the backpack **56** from the shoulders and spine to the lumbar region. This transfer is made by means of zip ties **40** or other tie types (tape, carabiner). A pair of zip ties **40** connect the lower parts **73** of the backpack **56** to the rear ends of the under-shoulder straps **3**, **4**. The shoulder straps **16**, **17** of the backpack serve to hold the backpack upright.

[0174] FIG. **57** shows a variation of the retrofitting shown in FIG. **56** to a known luggage bag by adapting it to be carried on the back. The carrying straps of the bag **75** can be used as shoulder straps. A pair of zip ties **40** connects the points of attachment of the carrying straps **75** of the bag with the rear ends of the under-shoulder straps **3**, **4** of the assembly. The fastening of the under-shoulder and hip straps to the lumbar brace in FIG. **57** is made by means of a three-way buckle, which enables individual adjustment of the lumbar brace to the spacing of the points of attachment of the carrying straps to the bag. FIG. **58** shows another known luggage bag from FIG. **57** in which two types of carrier straps are used interchangeably, as the carrier straps: a pair of straps **75** similar to those shown in FIG. **49**, and alternatively a carrying set consisting of two cross straps **77** connected by a strut **20**.

[0175] FIG. **59** and FIG. **60** show the luggage bag from FIG. **58** adapted to be carried on the back. This solution uses both types of straps from FIG. **58**, i.e. straps **75** and **77**. FIG. **59** shows a luggage bag standing vertically so that one cross strap **77** is at the bottom and the other is at the top. After adjusting length of the cross straps, the lower cross straps function as a pair of hip straps and the upper cross straps function as a pair of shoulder straps. The carrying straps **75** are pinned between the places where the lower cross strap is attached to the bag and the place where the upper cross strap is attached to the strut, thus acting as the right and left under-shoulder straps. FIG. **60** shows the luggage bag of FIG. **59** fitted over the user's body in a front view.

[0176] FIG. **61** shows the upper part of the carrying device retrofitting set (FIG. **65** and FIG. **66**) consisting of: upper connector **21**, pockets **45** for upper ends of the struts and tie straps **80**. The right strut is inserted into the right pocket **45**. Sewn to the right pocket are: the upper end of the right tie strap **80**, the right end of the upper connector **21**, and a half buckle of the buckle **79** blocking the slipping of the right strut. The second half-buckle of the pull-out locking buckle **79** is attached to the strut with a zip tie. To the left pocket **45** are sewn: the upper end of the left tie strap **80**, the left end of the upper connector **21**, a half-buckle of the buckle **79** blocking the slipping of the left strut. Double-hole buckles **70** are strung on the right and left tie strap **80**.

[0177] FIG. **62** shows how the upper part of the carrier retrofitting set shown in FIG. **61** is connected to the under-shoulder strap **4** of the carrier. The end of the tie strap **80** is threaded through the slot of the adjusting buckle **41** and then locked in the buckle of the double-hole buckle **70**. The user has two methods of adjusting the tension, one by adjusting the effective length of the tie strap **80** and the other by adjusting the length of the under-shoulder strap **4**.

[0178] FIG. **63** shows the lower part of the retrofitting set (FIG. **65** and FIG. **66**) consisting of: the lower connector **22**, a pocket **45** for the lower ends of the struts and the tie straps **81**. The lower end of the right strut is inserted into the right pocket. Sewn to the right pocket **45** are: the end of the right tie strap **81**, the right end of the bottom connector **22**, a half buckle of a buckle **79** blocking the slipping of the right strut. The second half-buckle of the pull-out locking buckle **79** is attached to the strut with a zip tie. Sewn to the left pocket **45** are: the lower end of the left tie strap **87**, the left end of the bottom connector **22**, a half-buckle of a buckle **79** blocking the slipping of the left strut. Double-hole buckles **70** are strung on the right and left tie straps.

[0179] FIG. **64** shows the attachment method of the lower part of the carrying device retrofitting set shown in FIG. **63** to the hip belt straps of the earlier. The end of the tie strap is threaded through the slot of the buckle of the hip belt and then locked in the buckle of the double-hole buckle **70**. The user has two methods of adjusting the tension, one by adjusting the effective length of the tie strap **81** and the other by adjusting the length of the hip straps **5**, **6**.

[0180] FIG. **65** shows a carrier retrofitting set. Technically, the assembly consists of an upper part shown in FIG. **61**, struts **18**, **19** and a lower part shown in FIG. **63**. Functionally, the set comprises a front brace and tie straps **81** for attaching the brace to the shoulder straps and the hip straps, respectively. The front brace consists of straight struts **18**, **19** (similarly to FIGS. **1**, **3**, **5**, **14**, **33**, **35**, **37**, **39**, **53**, **56**) connected with the upper connector **21** and the lower connector **22**. The modernization consists in adding a set to the carrying device harness as explained in FIGS. **62**, **64** and in the descriptions up to FIG. **66** and FIG. **67**.

[0181] FIG. **66** shows the carrying device retrofitting set differing from that of FIG. **61** in the shape of the struts. The bent struts **82**, **83** may better match the anatomy of the user. The construction of the set enables easy replacement of struts, which may have a different shape or length.

[0182] FIG. **67** shows the lower part of the carrying device retrofitting set as an alternative to that of FIG. **63**. In this alternative construction the lower connector is formed of a hip belt buckle **84** to which the pockets of the lower ends of the struts are attached. The hip belt buckle **84** is common to the lower connector and the hip straps of a carrying device, e.g. a backpack.

[0183] FIG. **68** shows the lower part of the retrofitting set as an alternative to FIG. **63** and FIG. **67**. In this alternative construction, the lower connector is formed of a hip belt buckle **84** to which two short straps are attached with sewn pockets for the lower ends of the struts. An adjusting buckle **85** is attached at the end of each tie strap, for threading and adjusting length of the hip straps of the carrying device, e.g. backpack.

LIST OF DESIGNATIONS

[0184] **1**. front brace
[0185] **2**. lumbar brace
[0186] **3**. right under-shoulder strap
[0187] **4**. left under-shoulder strap
[0188] **5**. right hip strap
[0189] **6**. left hip strap
[0190] **7**. hip belt
[0191] **8**. attachment poi of the right under-shoulder strap to the front brace
[0192] **9**. attachment point of the left under-shoulder strap to the front brace
[0193] **10**. attachment point of the right under-shoulder strap to the lumbar brace
[0194] **11**. attachment point of the left under-shoulder strap to e lumbar brace
[0195] **12**. attachment point of the right hip strap to the front brace
[0196] **13**. attachment point of the left hip strap to the front brace
[0197] **14**. attachment point of the right hip strap to the lumbar brace
[0198] **15**. attachment point of the left hip strap to the lumbar brace
[0199] **16**. right shoulder strap
[0200] **17**. left shoulder strap
[0201] **18**. right strut
[0202] **19** left strut
[0203] **20**. spacer
[0204] **21**. upper connector
[0205] **22**. lower connector
[0206] **23**. user's navel
[0207] **24**. level of the navel
[0208] **25**. anterior right upper iliac spine
[0209] **26**. the vertical plane tangent to the inner surface of the anterior right upper iliac spine
[0210] **27**. anterior left upper iliac spine
[0211] **28**. the vertical plane tangent to the inner surface of the anterior left upper iliac spine
[0212] **29**. pubic symphysis
[0213] **30**. level of the pubic symphysis
[0214] **31**. hinge
[0215] **32**. lock for telescopic tubes shift
[0216] **33**. foam cover for better grip comfort
[0217] **34**. front frame
[0218] **71**. safety hook with frame
[0219] **72**. belt length adjustment
[0220] **73**. place on the bottom of the backpack where the shoulder strap is attached
[0221] **74**. backpack compression strap
[0222] **75**. bag carrying strap
[0223] **76**. place for attaching the carrying strap to the bag
[0224] **77**. cross tape of the bag
[0225] **78**. non-stretchable braided strap
[0226] **79**. a buckle sewn on the pocket to block the strut from slipping out
[0227] **80**. tie strap attaching the front brace to the under-shoulder strap adjustment buckle
[0228] **81**. tie strap attaching the front brace to the hip strap adjustment buckle
[0229] **82**. right bent strut
[0230] **83**. left bent strut
[0231] **84**. central buckle of the hip belt
[0232] **85**. adjusting buckle of the hip belt
[0233] L**1**—the distance between the attachment points (**8**,**9**) of the under-shoulder straps (**3**,**4**) to the front brace (**1**)

[0234] L2—the distance between the attachment points (**12**,**13**) of the hip straps (**5**,**6**) to the front brace (**1**)

[0235] L3—the distance between the attachment point (**8**) of the right under-shoulder strap (**3**) to the front brace (**1**) and the attachment point (**12**) of the right hip strap (**5**) to the front brace (**1**)

[0236] L4—the distance between the attachment point (**9**) of the left under-shoulder strap (**4**) to the front brace (**1**) and the attachment point (**13**) of the left hip strap (**6**) to the front brace (**1**).

1. A load carrying device mounted on the body of the user,

a) having a frontal brace (**1**), a non-stretchable lumbar brace (**2**), a non-stretchable right under-shoulder strap (**3**), a non-stretchable left under shoulder strap (**4**), a non-stretchable left hip strap (**6**) and a non-stretchable right hip strap (**5**)—all connected to each other in relevant attachment points;

b) the front brace (**1**) has attachment points (**8**, **9**, **12**, **13**) for attaching the front ends of the right under-shoulder strap (**3**), left under-shoulder strap (**4**), right hip strap (**5**) and the left hip strap (**6**);

c) the lumbar brace (**2**) has attachment points (**10**, **11**, **14**, **15**) for attaching the rear ends of the right under-shoulder strap (**3**), the left under-shoulder strap (**4**), the right hip strap (**5**) and the left hip strap (**6**);

d) attachment points (**8**, **9**) of the under-shoulder straps (**3**, **4**) to the front brace (**1**) are located above the attachment points (**12**, **13**) of the hip straps (**5**, **6**) to this brace (**1**);

e) attachment points (**8**, **9**) of the under-shoulder straps (**3**, **4**) to the front brace (**1**) are located above the attachment points (**10**, **11**) of these straps (**3**, **4**) to the lumbar brace (**2**);

f) attachment points (**12**, **13**) of the hip straps (**5**, **6**) to the front brace (**1**) are located below the attachment points (**14**, **15**) of these straps (**5**, **6**) to the lumbar brace (**2**);

g) the distance (L**1**) between the attachment points (**8**, **9**) of the under-shoulder straps (**3**, **4**) to the front brace (**1**) does not exceed a preset value;

h) the distance (L**2**) between the attachment points (**12**, **13**) of the hip straps (**5**, **6**) to the front brace (**1**) does not exceed a preset value; characterized in that

i) the distance (L**3**) between the attachment point (**8**) of the front brace (**1**) to the right under-shoulder strap (**3**) and the attachment point (**12**) of the front brace (**1**) the right hip strap (**5**) is constant;

j) the distance (L**4**) between the attachment point (**9**) of the front brace (**1**) to the left under-shoulder strap (**4**) and the attachment point (**13**) of the front brace (**1**) the left hip strap (**6**) is constant;

k) the right under-shoulder strap (**3**) runs obliquely on right pars lateralis of the user's torso and has means (**72**) for adjusting s length;

l) the left under-shoulder strap (**4**) runs obliquely through left pars lateralis of the user's torso and has means (**72**) for adjusting its length;

m) the attachment points (**12**, **13**) of the hip straps (**5**, **6**) to the front brace (**1**) are in a space limited by vertical planes (**26**, **28**), parallel to the plane of symmetry of the user's body and tangent to the internal surface of his upper anterior iliac spines (**25**, **27**).

2. The device according to claim **1**, characterized in that the front brace (**1**) has the form of two elongated rigid struts (**18**, **19**) joined together by an upper (**21**) and a lower (**22**) horizontal connector made of non-stretchable tape and provided with means (**72**) for adjusting its length, while the lower connector (**22**) joins the lower ends (**20**) of the struts (**18**, **19**), and the upper connector (**21**) joins the struts (**18**, **19**) above the attachment points (**10**, **11**) of the under-shoulder straps (**3**,**4**) to the lumbar brace (**2**), while the attachment points the of hip straps (**12**, **13**) and the under-shoulder straps (**8**, **9**) to the front brace (**1**) are located on the struts (**18**, **19**).

3. The device according to claim **1**, characterized in that the hip straps (**5**, **6**) or the lumbar brace (**2**) comprises means for adjusting their length (**72**).

4. The device according to claim **3**, characterized in that means for adjusting the length (**72**) of the connectors (**21**, **22**) or the hip straps (**5**, **6**) or the lumbar brace (**2**) are separable.

5. The device according to claim **1**, characterized in that the front brace (**1**) has the form of a rigid frame (**34**) or plate.

6. The device according to claim **2**, characterized in that the struts (**18**, **19**) have the form of rods, advantageously hollow.

7. The device according to claim **2**, characterized in that the struts (**64**) have the form of flat bars.

8. The device according to claim **6**, characterized in that each strut (**18**, **19**) consists of a pair of telescopically connected tubes and is provided with a mechanism (**32**) preventing their movement relative to each other.

9. The device according to claim **6**, characterized in that the attachment point of the under-shoulder strap to the front brace has the form of a downwardly open pocket (**45**), located on the under-shoulder strap (**3**, **4**), the strut provided with means of preventing it from spontaneously slipping out of the pocket.

10. The device according to claim **6**, characterized in that the attachment point of the under-shoulder strap to the front brace is a tie (**40**) connecting the strut with the under-shoulder strap.

11. The device according to claim **6**, characterized in that the attachment point of the hip strap to the front brace has the form of an open pocket (**45**), located on the hip strap (**5**, **6**), the strut being provided with means of preventing it from spontaneously slipping out of the pocket.

12. The device according to claim **6**, characterized in that the attachment point of the hip strap to the front brace has the form of a buckle connected to the lower end of the strut, with the hip strap threaded through this buckle.

13. The device according to claim **12**, characterized in that the connection of the buckle to the strut is a tie.

14. The device according to claim **10**, characterized in that the tie is a plastic zip tie (**40**) or braided band or cable (**49**).

15. A kit of parts for retrofitting a load-carrying device mounted on the rear side of the user's body, having load securing means, hip belt and two shoulder straps, characterized in that it contains two elongated and rigid struts (**18**, **19**) having at first ends means for connecting the ends with the shoulder straps and having on second ends means for connecting the ends to the hip strap.

16. A kit of parts for retrofitting a load-carrying device mounted on the rear side of the user's body, having load securing means and two shoulder straps, characterized in that it contains two elongated and rigid struts (**18**, **19**) and a hip belt (**7**), the hip belt (**7**) has means for connecting the belt (**7**) to the lower part of the carrying device, the lower ends

of the struts have means for connecting them to the hip belt, while the upper ends of the struts have means for connecting them to the shoulder straps.

17. A method for retrofitting a load carrying device, containing load securing means (**56**), adjacent to the rear side of the user's body and a hip belt (**7**) and shoulder straps (**16**, **17**), characterized by using the kit of parts according to claim **16**, wherein the left and right elongated rigid struts (**19**, **18**) are attached with its upper ends to the middle part of the left and right shoulder straps (**16**, **17**) while their lower ends are attached to the hip belt (**7**) on the front side of the user's body.

18. A method for retrofitting a load carrying device, containing load securing means (**56**) adjacent to the rear side of the user body and shoulder straps, characterized by using the kit of parts according to claim **17**, wherein the left and right elongated rigid struts (**19**, **18**) are attached with their upper ends to the middle of the left and right shoulder straps (**16**, **17**) and the hip belt is placed between the shoulder straps and the load securing means

19. A method for retrofitting a load carrying device, containing load securing means (**56**) adjacent to the rear side of the user's body and shoulder straps, characterized in that the device according to claim **2** is used, wherein the lower ends of the under-shoulder straps (**3**, **4**) of the device are attached to the lower ends of the shoulder straps of the modernized device with the help of a tie.

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