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(54) Title: UPPER BODY SUPPORT AND PERFORMANCE ENHANCEMENT APRON

(57) Abstract: This invention is an upper body support and performance enhancement apron employing one or more super elastic components between upper body and lower body which is very flexible and provides natural support to human upper body when the body is bends forward and also generates upward power to assist upper body and reduce stress on upper thighs, and lower thighs when the body is stretched back from the bending position in carrying things, picking up things from lower position, house work, gardening, farming, elderly care support, factory work, warehouse work, and daily house work. The upper body support and performance enhancement apron has straps on its upper and lower part, is fixed on body, can be worn over clothes without incongruity and easily, and can be easily taken off from body. More specifically, the present invention is apparatus to support upper human body, employing shape memory alloy which shows super elastic effect and which doesn't create excessive stress when it's bent over a certain point of strain so that the people who wear the present invention doesn't get excessive pressure on chest when they bend forward and can naturally bend forward. The present invention reduces stress on waist, upper and lower legs by supporting upper body upon lower body part such as thighs. The apparatus consists one or more super elastic components which consist one or more super elastic wires which are combined at the both end of the wire by the parts, such as stainless steel hollow cases, which are designed to be able to replace super elastic wires, to adjust strength of the spring power of the super elastic wires and the length of the super elastic component and to easily replace the super elastic wire. The super elastic component is attached to the upper body support and performance enhancement apron by hooks or pockets and can be removed from upper body support and performance enhancement apron so that people can select to use the body support or not when the body support is not necessary or is inconvenient.

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Description

Upper Body Support and Performance Enhancement Apron

Technical Field

- [1] The current invention is concerning an upper body support and performance enhancement Apron that is easily worn over clothing and used to support an upper body and to enhance the upper body performance. More specifically, the invention relates to the upper body support and performance enhancement apron which is equipped with super elastic components and to the structure and the design of the super elastic component.

Background Art

- [2] The present invention can be easily worn on people's upper bodies without incongruity and naturally supports the upper body and enhances the upper body performance to reduce and prevent back pain in their activates in which people bend forward and return to the upright position. The present invention enhances the mobility of upper body, protects upper body muscles, spine, waist, and assist lifting items from lower position as experienced in daily house work, warehouse work, field work, elderly care work, and in sports activities. The present invention also supplies a bio-material (super elastic) apparatus which is to be integrated into a clothing.

Disclosure of Invention

Technical Problem

- [3] People working in factories, performing house work, gardening, farming, elderly care, and sports need to bend forward and backward frequently and as result have back pain or back injury.
- [4] When gardening, farming, and performing house work, a person is required to bend forward at their waist to pick up heavy items such as plants and bags, which increases ones risk of back injury. Similar condition can occur when participating in sports which requires rapid movements between bend forward position and upright position.
- [5] For elderly people, back pain and back injury are serious problems. In modern society younger people also do not exercise enough and receive back pain when bending forward and returning to upright position.
- [6] Other existing body support apparatuses available today uses spring steel plate for the body support component and constrains the body's flexibility.

Technical Solution

- [7] The current invention is to supply the super elastic apparatus which supplies natural body support and performance enhancement when it is integrated into a clothing. The current invention is also to supply the upper body support and performance en-

hancement apron into which the super elastic apparatus is integrated. The upper body support and performance enhancement apron supplies support and performance enhancement on an upper body to avoid or to reduce back pain and to improve the mobility of the upper body.

- [8] The super elastic apparatus is adjustable in size and strength, supports, and enhances a body bidirectionally, and is easily integrated into a clothing. The apron equipped with the super elastic apparatus can be easily worn by people of different generations and in different body sizes to perform house work, factory work, farm work, physical exercises, and rehabilitation to avoid or reduce back pain. Shape memory alloy, which comprises of the major part of the super elastic apparatus, generates more pressure, but the pressure doesn't linearly increase at more than certain stress point. So, the super elastic apparatus can supply very natural body support and performance enhancement in bending body activities. Although the super elastic apparatus does not generate excessive pressure on body when it's bent, it generates sufficient amount of power to assist your body when a body moves from its bent position to its upright position. The super elastic apparatus, fig-4, is implemented in the front part of the apron as figure-1.

Advantageous Effects

- [9] The present invention can make activities which require bending forward and backward such as gardening, house work, farm work, and elderly care work, much easier. This invention can be also be used at the factory where people need to keep their upper body in bend forward position long hours. In addition, if the super elastic apparatus is applied into different types of clothing, it can prevent back pain and support a body or a body part.
- [10] The super elastic apparatus is simple and compact, and can be easily applied to various types of clothing because it is adjustable in size and strength and works bidirectionally.
- [11] In trial phase, the people who worn the upper body support and performance enhancement apron didn't get back pain after keeping bending forward position for ten minutes. However, the people who did not wear the upper body support and performance enhancement apron got back pain in five minutes.
- [12] We tested the upper body support and performance enhancement apron and examined the effectiveness of the upper body support and performance enhancement apron by measuring muscle electric currency. The electromyogram, Fig-3, shows the result of the test.
- [13] One or more shape memory alloy wires comprises the superelasticity of the super elastic apparatus. Using one or more super elastic wires makes it possible that the super elastic apparatus becomes adjustable in strength and works bidirectionally. The

bidirectional super elastic structure makes it possible that the super elastic apparatus can be used on different types of clothing. apparatus is If a super elastic

- [14] Fig-2 shows the positions of the probes to measure muscle electricity in three different body positions. Figure (X) illustrates the person stands upright. Figure (Y) illustrates the person bends forward without wearing the upper body support and performance enhancement apron. Figure (Z) illustrates a person bends forward with the upper body support and performance enhancement apron. The points, A, B, and C on these figures are the position where the probes were attached to measure the muscle elect activities. The table below shows the changes in muscular strength which was measured between point A and point C and between point B and pint C.

[15]

	Muscular Strength (mV)	Tolerance
Stand Straight Up	0.48	+/- 0.003
Bend Forward without the Apron	1.00	+/- 0.17
Bend Forward with the Apron	0.80	+/- 0.11

- [16] The result of the test indicated that when the person bend forward without wearing the upper body support and performance enhancement apron, the muscular electricity increased from 0.48 to 1.00, which was two times more than when the body is straight up. The result also shows when you worn the upper body support and performance enhancement apron, the muscular electricity increased from 0.48 to 0.80, which is 20 percent less than when a person did not wear the upper body support and performance enhancement apron. Besides, the tolerance which is caused by muscular fatigue was 0.17 when a person did not wear the upper body support and performance enhancement apron and 0.11 when a person worn the upper body support and performance enhancement apron. It indicates that the upper body support and performance enhancement apron reduced the muscular fatigue by 40%. The result indicates that the upper body support and performance enhancement apron effectively supports the muscles and enhanced muscular strength..

- [17] Fig-3 is the electromyogram we obtained in the test and shows the result of the experimentation in [11] and[13].

Description of Drawings

- [18] The nature and advantages of the invention will become more apparent from the following detailed description of the invention when taken in conjunction with the accompanying exemplary drawings.

- [19] [fig-1] is a view of the upper body support and performance enhancement apron which is corresponding to the super elastic apparatus. Fig-1a shows how the super elastic apparatus which is integrated in the upper body support and performance enhancement apron supports the upper body when a person who wears the upper body support and performance enhancement apron bends forward. Fig-1b is a front view of an embodiment of the upper body support and performance enhancement apron worn on a human body.
- [20] [fig-2] shows the actual position of the probes attached on a human body used to measure the effect of the current invention which is corresponding with section [11], [12], and [13].
- [21] [fig-3] is the electromyogram which was obtained in the test of the upper body support and performance enhancement apron which is corresponding to [11], [12], and [13]. The electromyogram indicates the effectiveness of the current invention when the current invention is actually used in a real work.
- [22] [fig-4] is views of the embodiment of the super elastic apparatus according to the principles of the invention. Fig (a) is a view of the super elastic apparatus in which shape memory alloy wires are aligned. Fig (b) is a view of the super elastic apparatus in which shape memory alloy wires are twisted.
- [23] [fig-5] is a view of an embodiment of the upper body support and performance enhancement apron according to the principles of the invention.
- [24] [fig-6] is a view of an embodiment of the elastic apparatus with a case which is used to connect the super elastic apparatus on a clothing according to the principles of the invention.
- [25] [fig-7] is the view of an alternative embodiment of the elastic apparatus.
- [26] [fig-8] is views of alternative embodiments of the fixing method of the super elastic apparatus to the upper body support and performance enhancement apron. The figure is also views of alternative embodiments of the different number of the super elastic apparatus applied to the upper body support and performance enhancement apron.
- [27] [fig-9] is a side view of the upper body support and performance enhancement apron worn on a human body according to the principles of the invention. The figure shows how the lower part of the upper body support and performance enhancement apron is loosely fixed on a body around thighs by strap, 10a and 10b according to the principles of the invention.
- [28] [fig-10] is a side view of the upper body support and performance enhancement apron worn on a body according to the principles of the invention. The figure shows the lower end of the super elastic apparatus is not fixed on the upper body support and performance enhancement apparatus.
- [29] [fig-11] is front and back view of the upper body support and performance en-

hancement apron actually worn on a human body according to the principles of the invention.

[30] A brief explanation of the figures used in this document:

[31] A list of explanations of the part numbers used in figure 1 through figure 11.

numbers	Explanation
1, 1'	super elastic apparatus
2a 2b	hollow parts
3a 3b	stoppers
4a, 4b	pockets with plastic board
5	upper body support and performance enhancement apron
5a, 5b	spacers
6	pocket with plastic board
7	neck strap
8	case
9a, 9b	Waist Strap
10a, 10b	leg straps
11	bending point
A	Test measure point
B	Test measure point
C	Base test measure point
12	snap hook
13	shape memory wires

Best Mode

[32] The super elastic apparatus can be applied for different types of clothing, such as apron, overalls, and other types of clothing. If a clothing has upper body part and lower body part, each part can have the super elastic apparatus. Because the super elastic apparatus is adjustable in size and in strength and works bidirectionally, it can be used with various types and sizes of clothing.

[33] The upper body support and performance enhancement apron uses one or more of the super elastic apparatus according to the needs.

[34] Fig-4 is views of the structures of embodiments of the super elastic apparatus. We found that these design makes it possible that the super elastic apparatus has scalability

in size and strength and keep bidirectional superelasticity. If a shape memory plate is used instead of the super elastic wires, the super elastic apparatus lost bidirectional superelasticity.

- [35] In Fig-4 part 13 is shape memory alloy wires. In this example the length of the shape memory alloy wire is 490mm and the diameter is 2mm. Four shape memory alloy wires are used. Part 2a and 2b are hollow parts in which the both ends of part 1, shape memory alloy component, are inserted. In this example 2a is 200 mm length stainless steel tube, and 2b is 140mm length stainless steel tube. 3a and 3b parts are stoppers plugged in the stainless steel tubes to prevent the shape memory alloy wire from dropping off. You can remove stopper 3a and 3b and take in and out part 1, shape memory alloy wires so that you can adjust the strength of the elasticity of the super elastic component for each individual by adjusting the number and the diameter of the shape memory alloy wire.
- [36] When the super elastic wire bends many times, it gets fatigue at the bend position, and loses its super elastic character. In this invention, the bend position of the super elastic wire can be adjusted by placing one or more spacers at the both ends or the either end of the super elastic material.
- [37] The part of the shape memory alloy wire which actually can bend is the wire between stopper 2a and 2b. The length of the wire between stopper 2a and 2b is 210 mm (13 in fig-4). If the length is too short, the wire will be deformed. If the length is too long, the wire doesn't support body stably.
- [38] Fig-5 shows the shape memory alloy component inserted in stainless tube 2a and 2b and installed on upper body support and performance enhancement apron 5. Two super elastic components are used on the left and the right side. For light amount of work only one of them may be enough.
- [39] Part 6 is a plastic plate whose thickness is between 1 mm and 2 mm, and is installed between upper body support and performance enhancement apron 5 and the end of the super elastic component. The plastic plate evenly distributes the pressure from the super elastic component when the body is bent forward.
- [40] Part 7, 9, 10 are straps to fix the upper body support and performance enhancement apron on a body. Part 7 is a neck strap, Part 9a and 9b are straps to engage the upper body support and performance enhancement apron on a body at waist position, and part 10a and 10b are straps to engage the lower portion of the upper body support and performance enhancement apron to a lower body which is around thighs. The super elastic apparatuses equipped in the upper body support and performance enhancement apron become effective to support the upper body by engaging the outfit to the upper body. The outfit doesn't need to be tightly fixed on a human body.
- [41] Fig-6 is an embodiment of the method of connecting super elastic apparatus. The

super elastic apparatus is placed in a case fixed on article of clothing. FIG-5 shows a view of an embodiment of the fix method. The case can be replaced with a pocket fixed on article of clothing. The upper part of the case (corresponding to stainless steel tube 2a) is placed at chest, and the lower part of the case (corresponding to stainless steel tube 2b) is placed at thighs. The exposed part of the shape memory alloy wire is bent and generates power to support body, and it is more efficient if it's located on a hip area. Also, it is possible to adjust the position of the both end of the super elastic apparatus to the best position of an individual user. Besides, the both ends of the case are opened, and the shape memory alloy wire, stainless tube 2a and 2b can be removed and replaced.

[42] Fig-7 is a view of an alternative embodiment of the super elastic apparatus. The shape of the embodiment has up-side-down Y-shape. The one side of the case is spread into two parts and fixed on both thighs. If the case is fixed on both thighs, it can prevent side slip. It is better that the position of the split of the case is located around the bottom part of ribs. If it is placed as described, the shape memory alloy 1 does not move upright direction against gravity by the effect of spacer 5a.

[43] Fig-8 is a view of an alternative embodiments of the fixing method of the super elastic apparatus on the upper body support and performance enhancement apron. The super elastic apparatus is placed in up-side-down V-shape. If the super elastic apparatus is up-side-down Y-shape as fig-7, the shape memory alloy wire component doesn't smoothly slide inside the hollow parts, moves upward toward upper chest, and causes the user to feel upward pressure on chest. However, if the super elastic apparatus is placed on the apron in up-side-down V-shape position, the super elastic component can smoothly slide inside the case 8 in FIG-8 and doesn't cause the user to feel the upward pressure on chest.

[44] The super elastic apparatus can be fixed by inserting it in the pockets or case 8 fixed on the upper body support and performance enhancement apron 5 in fig-5. The case 8 can be removable if it is fixed by hooks fixed on the upper body support and performance enhancement apron. Two plastic plates are integrated in the inside of the pocket to make enough strength to hold the super elastic apparatus.

[45] The length of the super elastic apparatus is adjustable by placing spacers at the both end of the super elastic apparatus to control the strain of the shape memory alloy wire and the stress. If you change the length of the shape memory alloy wire to adjust the length of the super elastic apparatus to make it fit with the size of the article of the clothing on which the super elastic apparatus is used, the strain and the stress of the shape memory alloy wires may unexpectedly change, and the super elastic apparatus does not work as expected.

[46] The upper body support and performance enhancement apron is engaged to a body

around neck, waist and thighs. The method of engaging the apron and a body does not constrain the body's flexibility.

- [47] If a user of the current invention bends forward deeply and keeps the position long time, the user may not want the upward power generated by the super elastic component. If a user wants to reduce the upward pressure from the super elastic component, the user can stick out the lower end of the case. When the end of the super elastic component is stick out from the pocket, it doesn't generate upward pressure on the user's body, and the user can easily work. If a user wants to use the upper body support and performance enhancement apron without the super elastic apparatus, the user can remove the super elastic apparatus from the upper body support and performance enhancement apron, and the upper body support and performance enhancement apron works as an ordinary apron.

Mode for Invention

[48]

Industrial Applicability

[49]

Sequence List Text

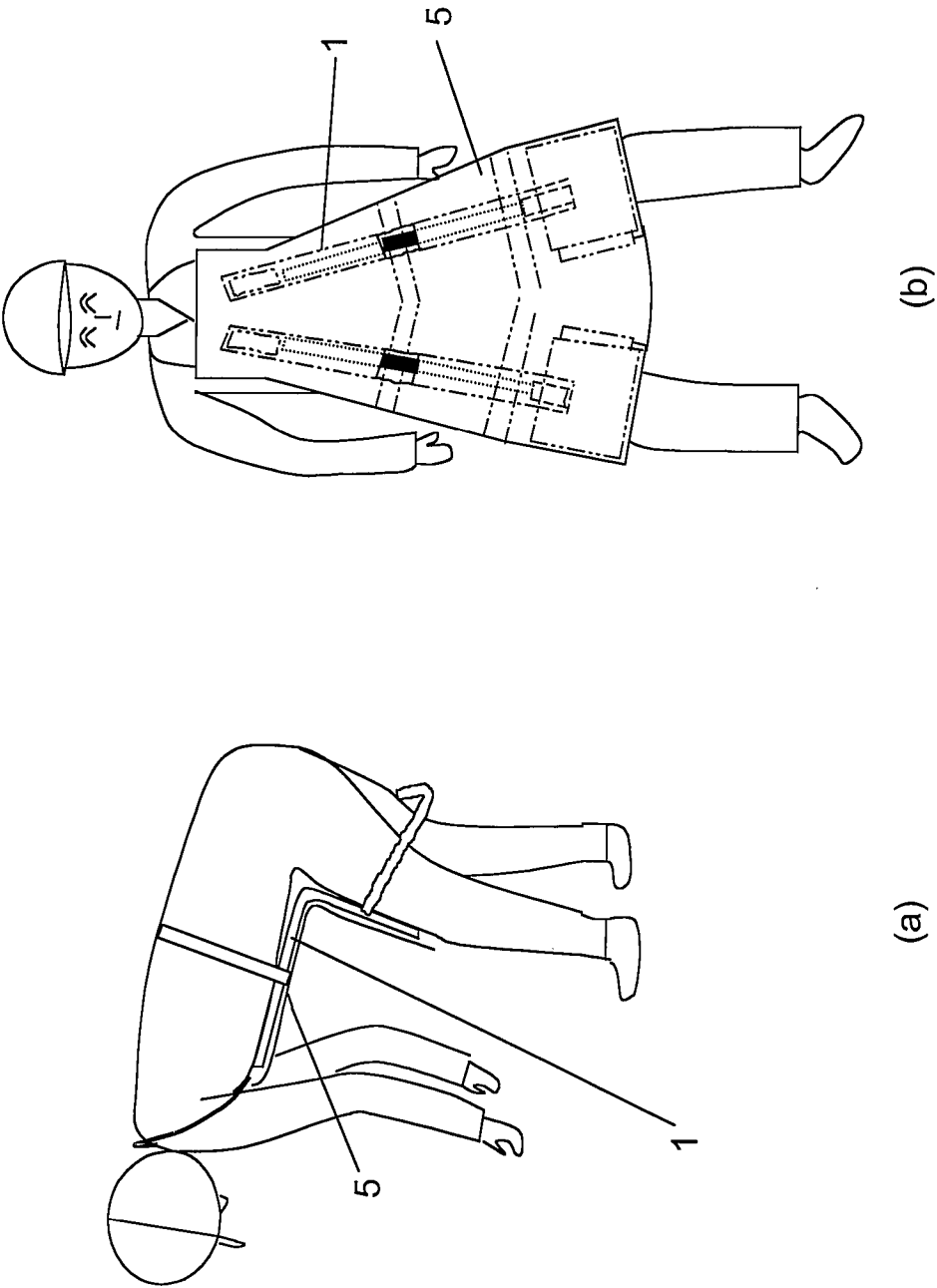
[50]

Claims

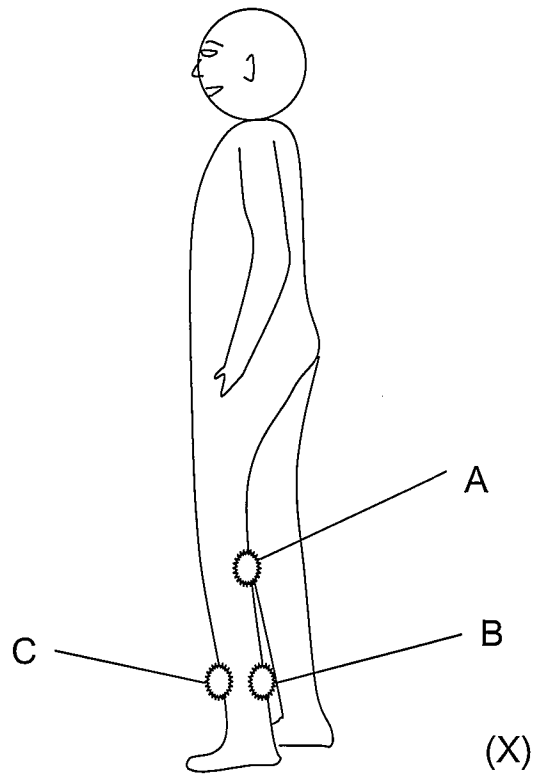
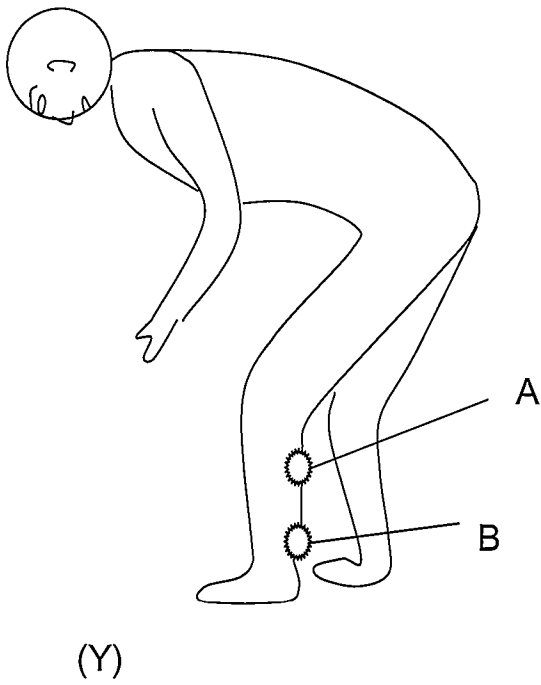
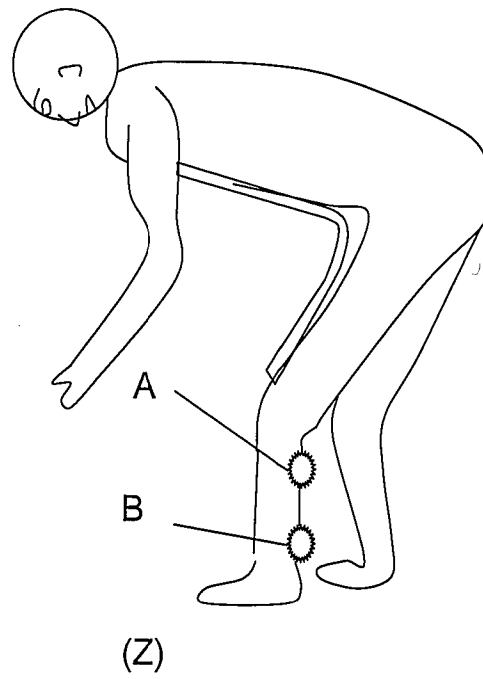
- [1] The current invention is the upper body support and performance enhancement apron which supports an upper body and enhances the body's ability of bending forward and returning to upright position . The upper body support and performance enhancement apron is engaged to a human upper body by a neck strap, a waist strap, and a lower strap. The upper body support and performance enhancement apron is composed with one or more detachable super elastic apparatuses which is adjustable in size and strength and has bidirectional superelasticity. The super elastic apparatus applied on the upper body support and performance enhancement apron is placed between upper body and lower body part. The current invention also includes the super elastic apparatus which is integrated into a clothing and supports a bending part of a body. The super elastic apparatus contains combined shape memory alloy wires or other super elastic material wires combined by hollow parts or plastic parts at the both end of the wire. The strain of the super elastic apparatus can be adjusted by the spacers which are placed at the both ends or either end of the combined wires.
- [2] The apparatus of claim 1, wherein the upper body support and performance enhancement apron contains one or more super elastic apparatus between the upper and the lower part of the apron.
- [3] The apparatus of claim 1, the upper body support and performance enhancement apron has a neck, waist, and lower strap, and is engaged to a human upper body by the straps.
- [4] The apparatus of claim 1, wherein the super elastic apparatus uses combined shape memory alloy wires or other super elastic material wires.
- [5] The apparatus of claim 1, wherein the super elastic apparatus is detachable.
- [6] The apparatus of claim 1, wherein the super elastic component is fixed on the apron by placing it in the pockets or cases which are fixed on the clothing.
- [7] The apparatus of claim 1, wherein the super elastic wires are hold in hollow parts at the both ends of the super elastic wires.
- [8] The apparatus of claim 1, wherein the hollow parts are independent.
- [9] The apparatus of claim 1, wherein the super elastic apparatus is made by one or more super elastic wires, removable from the hollow parts, adjustable, and replaceable.
- [10] The apparatus of claim 1, wherein the super elastic component with/without the hollow parts is placed in a case.
- [11] The apparatus of claim 1, wherein the super elastic component with the hollow parts is removable and replaceable when it is set in the case.

- [12] The apparatus of claim 1, wherein the bend position of the super elastic component is adjusted by placing spacer between the each end of the super elastic component and the bottom of the hollow part. The spacer also controls the strain of the shape memory alloy wires.

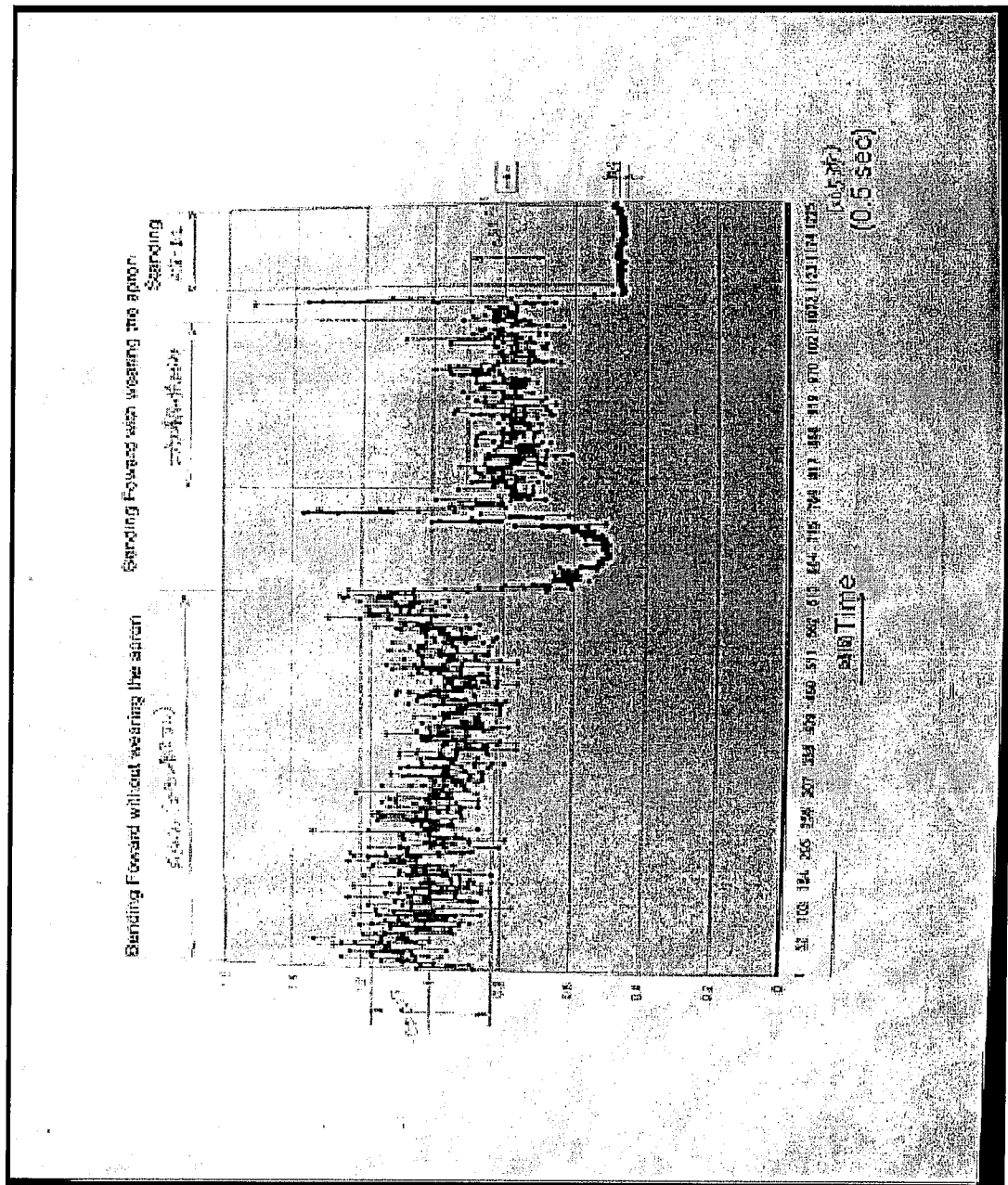
[FIG-1]



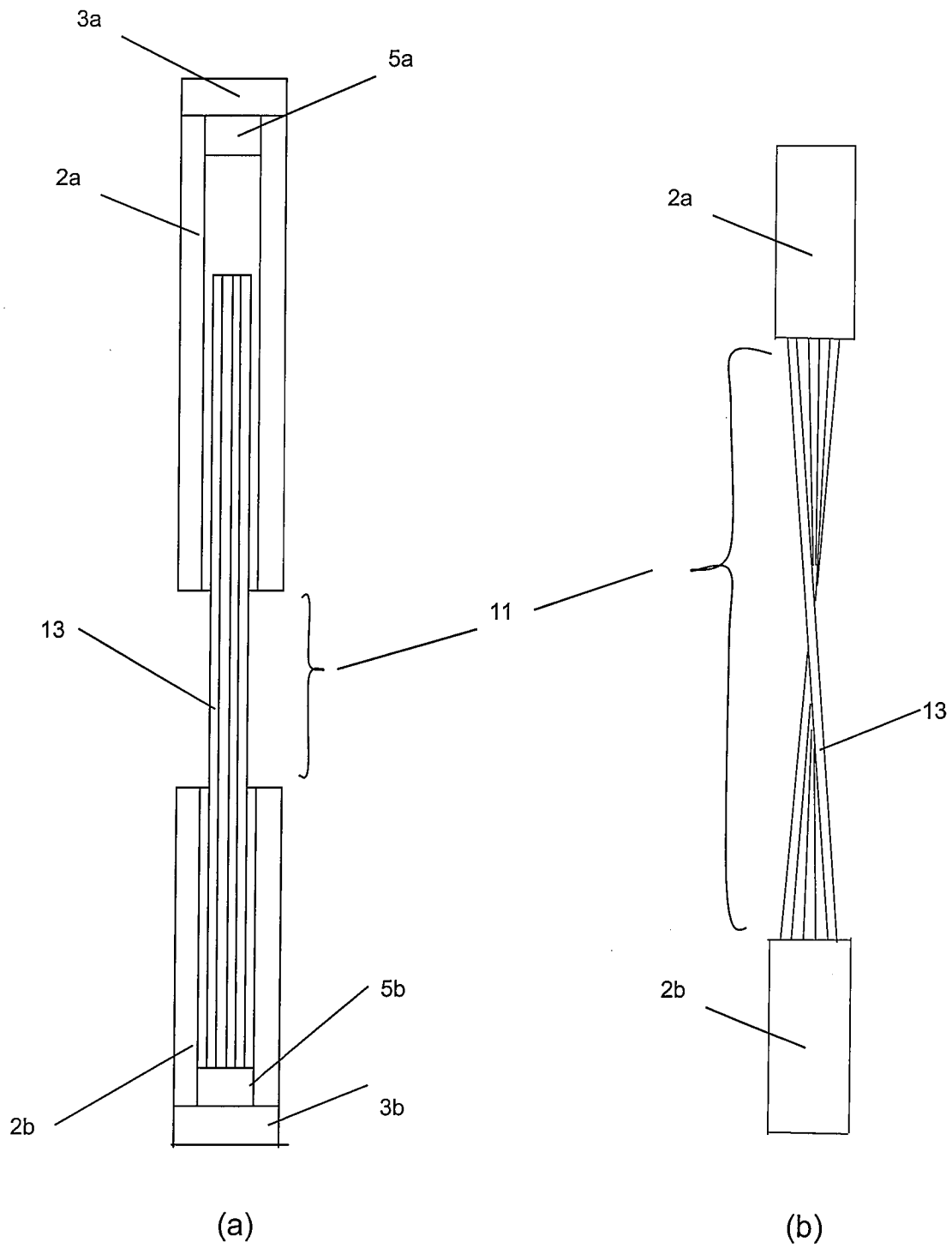
[FIG-2]



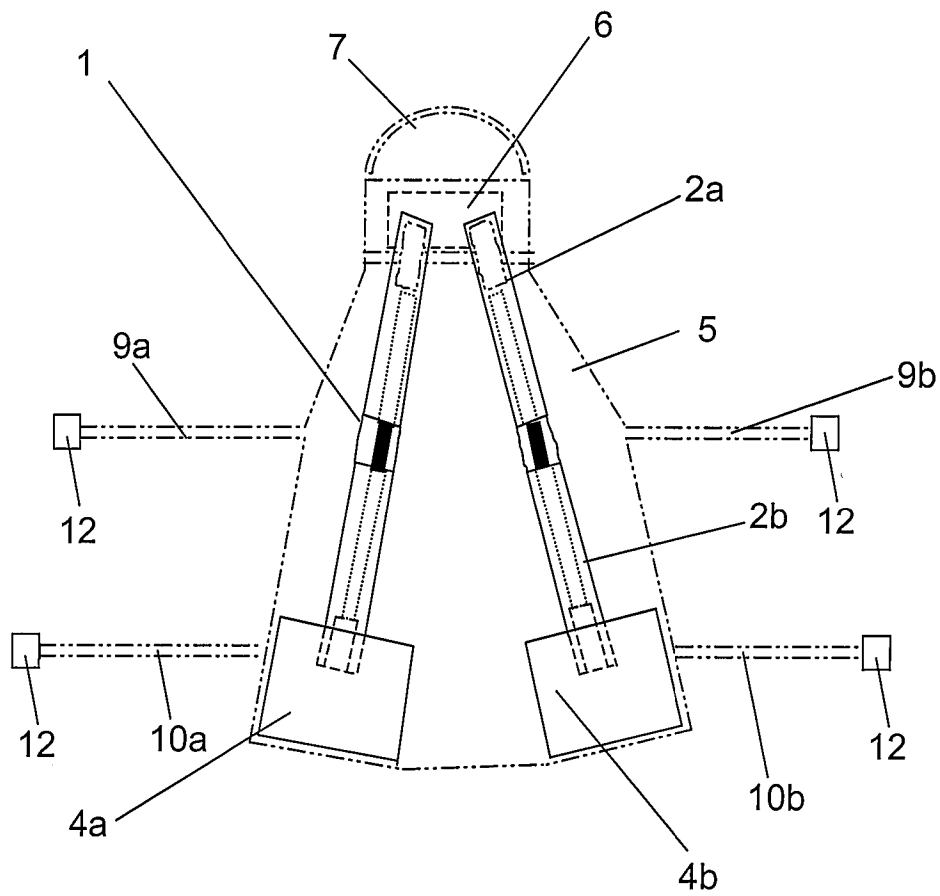
[FIG-3]



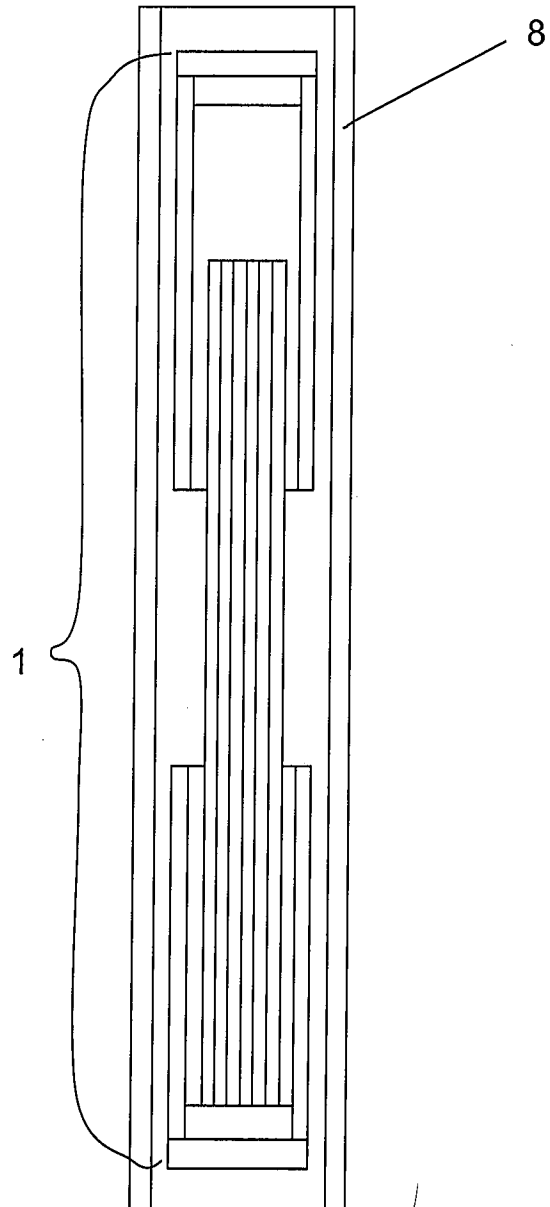
[FIG-4]



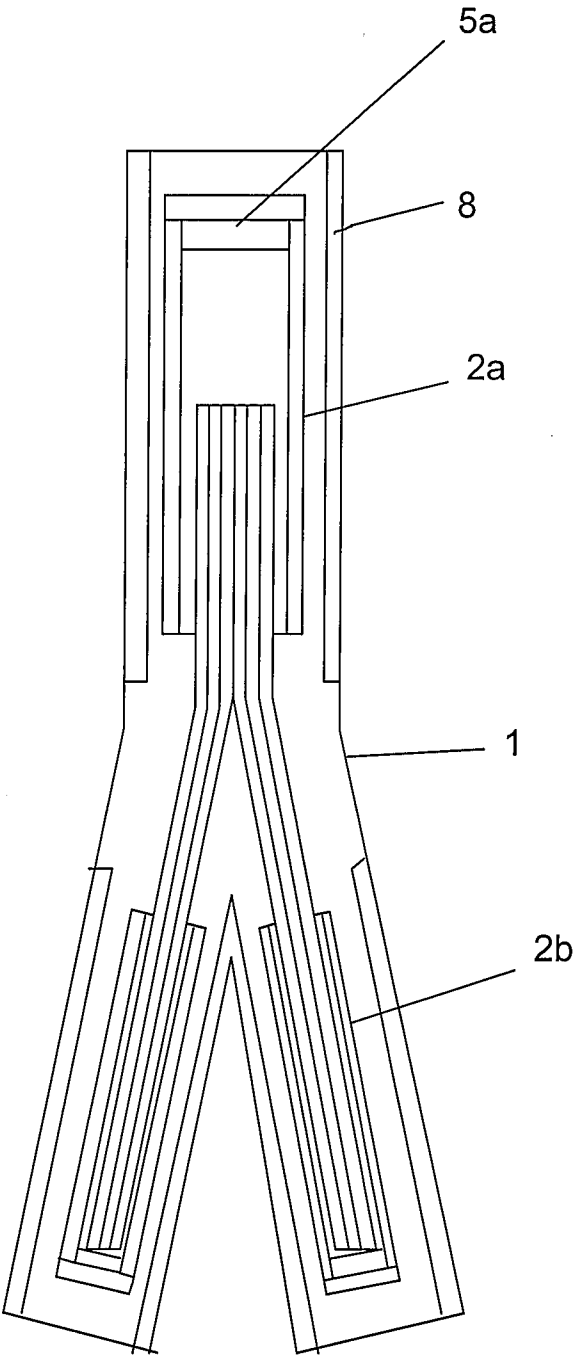
[FIG-5]



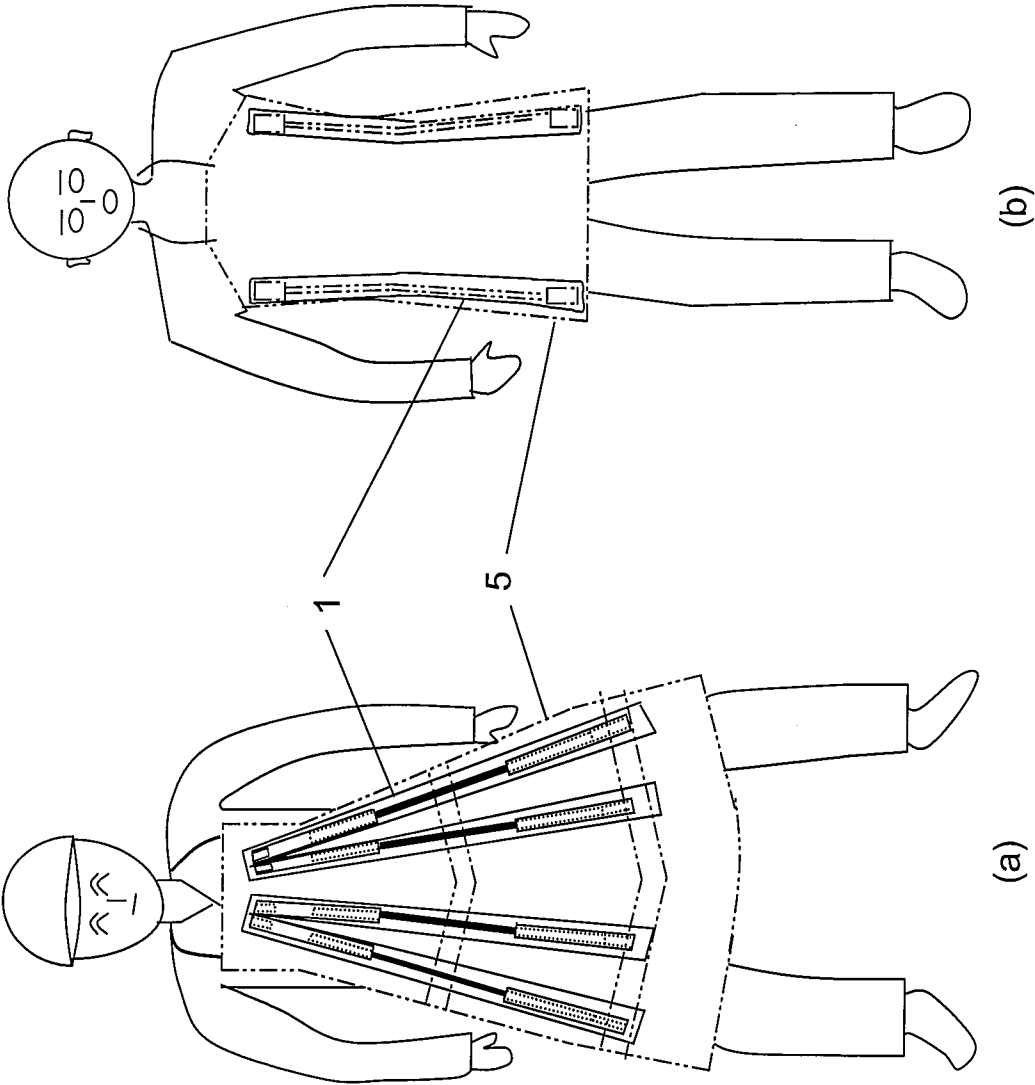
[FIG-6]



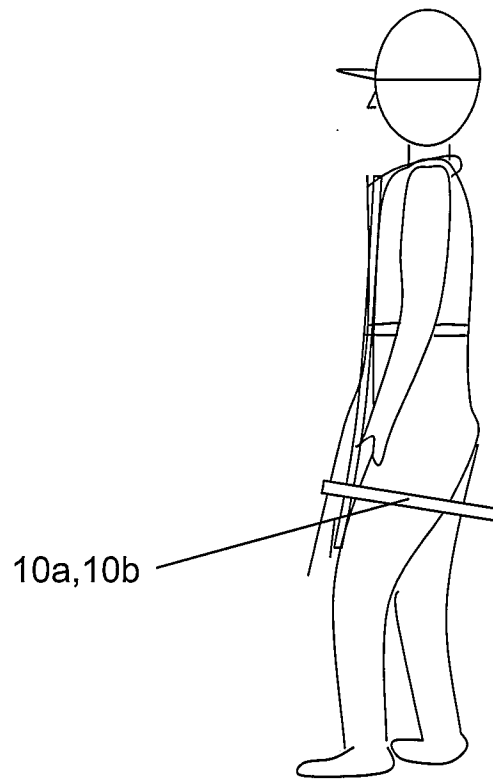
[FIG-7]

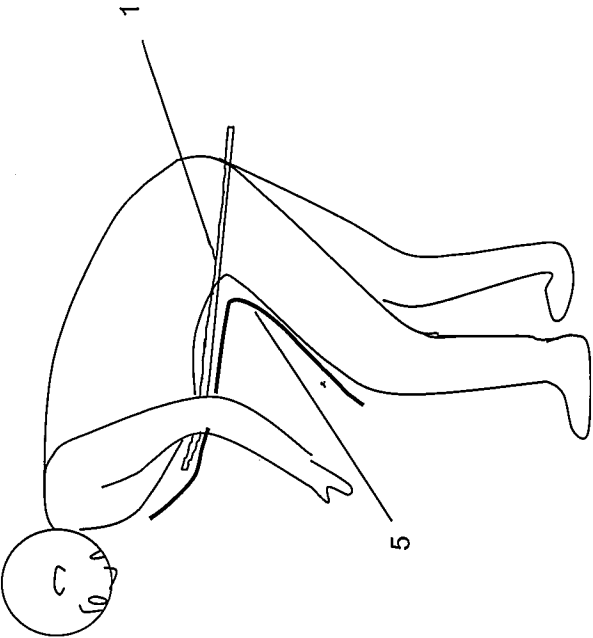
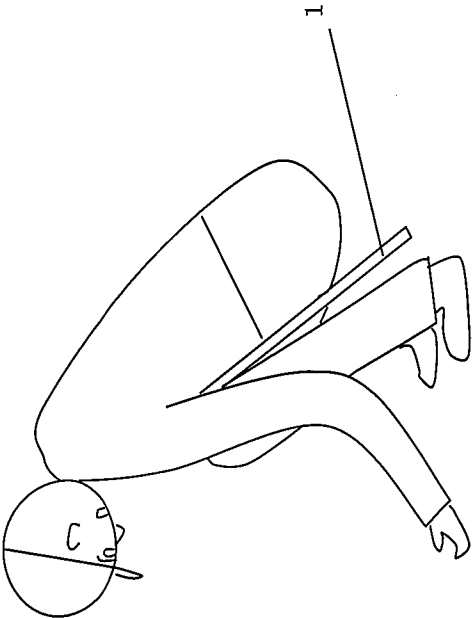


[FIG-8]

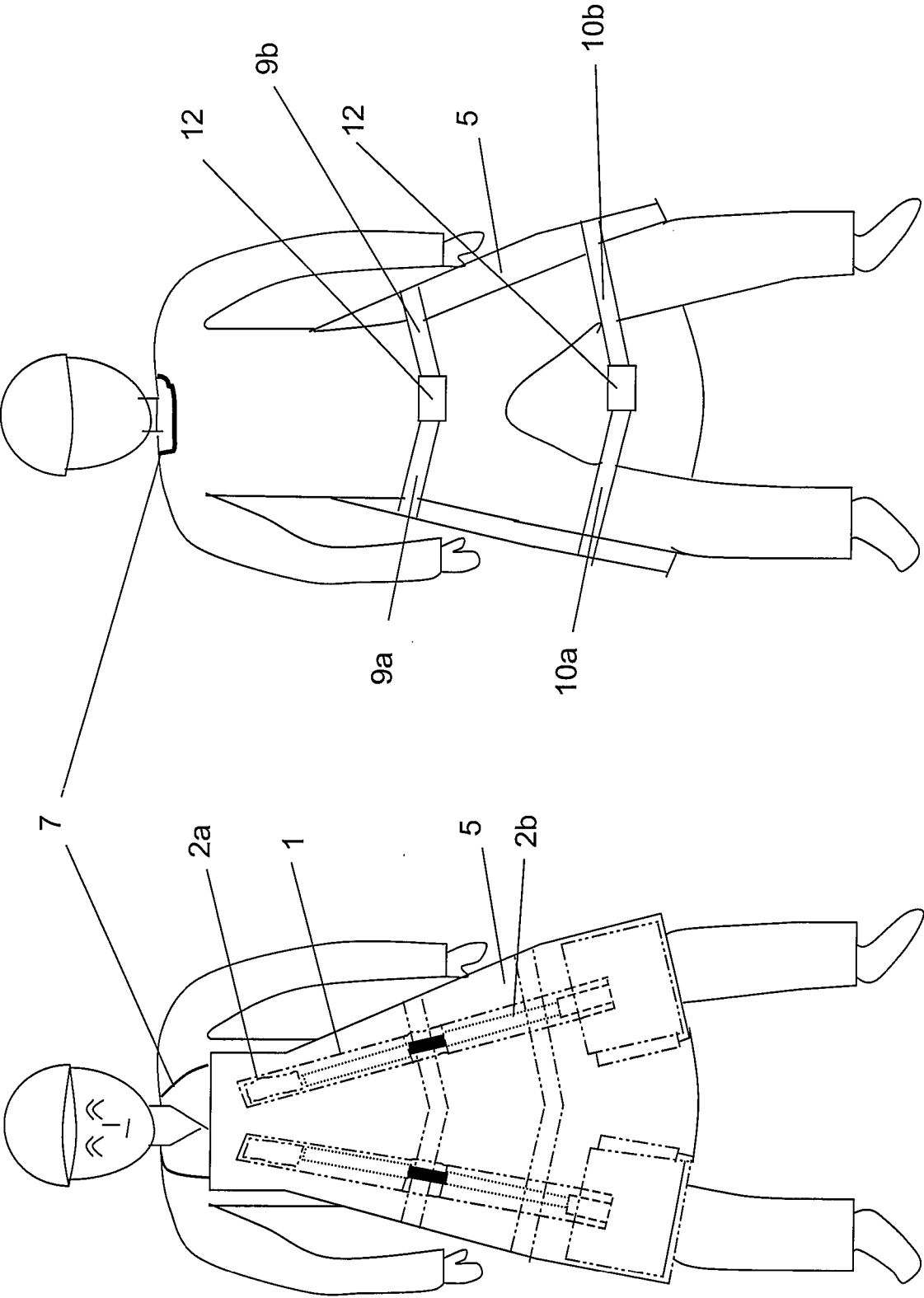


[FIG-9]





[FIG-10]



[FIG-11]