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# (54) GRAVITATIONAL FOOTWEAR (VARIANTS) AND SPRING UNIT

(57) The supporting element of gravity footwear, made up in the form of a shoe, a boot etc. with accumulation of energy, caused by deflecting, comprising flexure spring, the topmost of the shoe equipped with fixing device, joined to the spring, sole and other elements of the shoe, is made up in the form of a heel, or a heel and a sole, or a sole, gravitational effect on the spring is communicated by a cuff and/or a stiff cover as well as out of any other soft suspending element, wherein the distance between the ends of the spring when load is not applied to the spring is greater than the distance between a point of suspending and the lowest point of the user's foot, the spring is equipped with a fixing device. The heel is a supporting element within the spring unit, jointly used with conventional footwear as a device, intended to accumulate energy and comprising a flexure spring, joined through the element, which communicates gravitational effect on the spring and the user's foot. When the spring is compressed the sole is an additional supporting element.

Fig. 18a

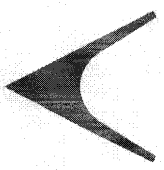

Fig. 18b

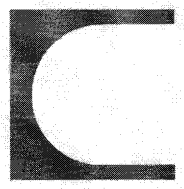

Fig. 18c

Fig. 18d

Fig. 18e

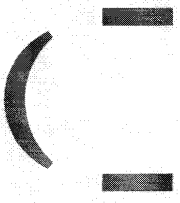

Fig. 18f

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## Description

**[0001]** The invention relates to footwear, which ensures accumulation of energy by means of a spring, compressive under user's body mass and usage of this energy when the spring is released to push user's foot upward. The said footwear can be used in every day wearing as a sport's footwear namely as racing, jumping, skiing, sliding, rolling shoes etc. as well as a device that complements conventional shoes to provide accumulation of energy.

**[0002]** The known device that facilitates jumping by means of an arched (bow-shaped) spring, accumulating energy when it is compressed and communicating this energy when the spring is released was designed and patented by Alexander Borg (see patent US 6719671).

**[0003]** This removable device comprises:

- bow-shaped leaf spring, designed to recurrent deflection (compression, flexure, convergence of the ends of the spring) under application of user's body mass gravity forces along while accumulating a part of this energy and release (extension, distancing of the ends of the spring) when user's body mass is removed on the spring (e.g. when user's body mass is communicated from one foot to another) with exerting of accumulated energy and its application to a user's foot in the form of repulsion towards and upwards.; the lower part of the string is provided with a supporting element to interact with the supporting surface;
- hinge-lever mechanism, situated on a concave side of the bow-shaped spring and fixed at the user's foot and mainly at his/her knee, comprises:
    - base to accommodate user's foot (platform, support), joined at least in two points to the spring and equipped with a supporting element.
    - central support (rigid vertical element), fixed to a user's knee with a knee belt and joined on top to the upper part of the leaf spring by a hinge-lever mechanism , and joined stiff to a base, located at angle 90 against the central support;
    - articulated connecting rod between the forepart of the base and an area of the lower arm of the spring, distant at around 1/3 of its end with supporting element, articulated connecting rod includes a shackle interacting with the spring;
    - supporting element to support the base in a given position relative to the central support;

**[0004]** The enhancement created by a user (runner) is communicated to the spring by two ways. The first way provides communication through the lever mechanism and the upper fixing element on the top of the spring, then from the latter through the supporting element on the supporting surface. The second one provides communication through the shackle on the lower part of the leaf spring.

**[0005]** The weak point of this device lies in inability of its exploitation, impossibility to use it in every day life. The only possible way to move is jumping or racing. Beside this, the given device eliminates a range of technical imperfections inclusive of unreliable fixation of the base to a foot: the obliquity is still possible even having a supporting device when user's body mass becomes greater.

**[0006]** Another known device is the one, designated for jumping. It represents the advanced design described hereinabove and developed by Tea-Hyuk Hoon, patented in several countries (see patent US 6840893).

**[0007]** This known device includes:

- bow-shaped leaf spring, intended to recurrent flexible deformation (compression, flexure, convergence of the ends of the spring to each other) under gravitational effect of user's body mass with accumulation of the part this energy and release (extension, distancing of the of the ends of the spring from each other) when the load is removed from the user's body mass on the spring (e.g. When transferring user's body mass on the other foot) with the release of accumulated energy and its application to user's foot in the form of repulsion towards and upwards, the lower arm of the spring is provided with a wear-resistant supporting element for interaction with the surface;
- Lever mechanism, located on the concave side of the bow-shaped spring, fastened to the foot of the user, mainly to his knee, and comprising:
    * base to accommodate user's leg (platform, support) at least in two points associated with the spring, and furnished with a "coat", providing safe fixing of user's feet to a platform, i.e. acting as a top of the shoe and/or fixing elements;
    * vertical element (central support), fastened to the knee of the user with help of knee-pads provided with strips, partially embracing user's shin and joined to a top to the upper part of the leaf spring, while the lower part is rigidly fastened to the platform, located in regard to the vertical element at an angle of 90 °;
    * hinge-linkage between the front part of the base and the area of the lower arm of the spring, slightly removed (at about 1/3) from its end by a supporting element; one of the elements of this connection is installed with the possibility of abutment to a spring in its compressed state;

**[0008]** The principle of operation of this device is similar to the principle of the device patented under No. US 6719671. The basis of its operation is established on the spring bending under the action of potential and kinetic energy of the user's body mass, while energy is being accumulated and followed by subsequent release of the spring with simultaneous exertion of stored energy and

focusing this energy on moving forwards and upwards of the user.

**[0009]** Though, the complexity of this device, inability of exploitation, impossibility to use it in everyday life represents a great disadvantage of this device. Displacement using such device requires considerable effort, special skills and a well-developed coordination system. Besides, displacement using such device is only possible through jumping or racing. Movement increments are impossible.

**[0010]** Special footwear, as described in the application № 2008107517 dated 28.02.2009 for the grant of a patent on the invention of the Russian Federation, and the decision to award such patent was made according to the above-mentioned application has been designed in order to use the principle of operation of the stored energy by means of bending the spring, that rests on the ground or on another supporting surface when exposed to user's mass and to the subsequent liberation of energy during release of the spring using this liberated energy to push user's feet without special removable devices, but directly in the shoe. This footwear was chosen as a prototype.

**[0011]** This footwear, such as shoes, boots, etc., designed with energy storage, induced by elastic deformation, includes:

- elastic outsole, which may partially or completely contact with supporting surface;
- elastic rear part joined to this outsole (fabricated all in one piece with the said elastic outsole), and
- retention mechanism to fix user's foot position on the sole, mechanisms being joined to the outsole and rear part;
- wherein the rear part and the outsole form a leaf spring of the given flexibility, providing deflection, the rear part and the outsole being at the same time arms of the leaf spring;
- wherein the leaf spring elastically deformed from the initial state to a compressed state;
- wherein the rear part and the outsole are initially positioned at an angle of 90 ° to each other, and
- wherein the angle of the leaf spring in its compressed state between the outsole and the rear part is reduced.

**[0012]** The relative complexity of displacements with such device, especially at a large angle between the arms of the spring represents disadvantageous features of this footwear.

**[0013]** The rate of the load compressing the spring being in the form of the outsole and the rear part, is determined by the weight of the user, but also by strength of his foot muscles. Generally the load (gravitational force exerted by the user's mass and the energy made by the muscles) is communicated on the lower arm of the spring (the impact on the user's foot) or on the bottom of the upper arm of the spring (the impact on the elastic rear part, for example, by the heel of the user), resulting in a gravitational influence on the spring in the shoe is insufficiently effective.

**[0014]** The displacement when wearing such footwear with a periodic compression and deflection of the spring requires an initial standing pose on tiptoe and then lowering heels till the contact of the whole sole or of its most part with the supporting surface.

**[0015]** Such displacement differs from the ordinary contact with the supporting surface when walking. First you stand on the heel, and then you're dragging the whole foot down and slide upward on the toe.

**[0016]** The construction described above under patent US 6840893 may serve as the closest prototype of the spring unit. It includes:

- bow-shaped leaf spring provided with a wear-proof supporting element;
- device to send the gravitational effect on the spring, fastened to the user's foot and comprising a base with a "coat" to accommodate a foot, joined by a stiff updraft with the top of the spring.

**[0017]** At the same time it is not the bottommost to accommodate a feet. It has not contact with supposing surface, being fastened stiff and perpendicularly to the updraft. The distance of the updraft is always less than the distance between the upper and the low ends of the spring, even if the latter is fully loaded (at bending, compression).

**[0018]** The disadvantage of the device - the prototype lies in inability to move a simple step when wearing such device. It allows only jump moving and this may be explained by the fact that the user always has only one point of support - the lower end of the spring.

**[0019]** The objective of the present invention is to increase the effective use of gravitational effect communicated on the spring, that accumulates energy when it is bent (compressed) and exerts the stored energy for an extra push of the user's feet by optimizing the communication of the load on the spring and allowing the release of energy at a given time, along with facilitating of displacement through the prior use of gravity character of the foot's rock-up from heel to toe.

**[0020]** Another challenge is to create a simple accessory device of the spring unit type to complement ordinary footwear, which will provide, in addition to the above-mentioned solutions, the ability to move at a footpace being supported at two points (for example, the lower end of the spring and the outsole of the regular footwear).

**[0021]** Once the challenge has been set, the applicant considers it is appropriate to use the word "gravity" in the title the invention.

**[0022]** These objectives shall be met by means of gravity footwear (shoes, boots, etc.) with the accumulation of energy exerted after deflection, including:

- spring unit comprising at least one bending spring

of required flexibility, formed by footwear components and deflecting from the initial state to a compressed one.

- at the same time the lower part of the spring shall serve the supporting element aimed to contact with the surface;
- the upper part of the shoe with fixing devices to fix the position of user's feet and to communicate gravitational effect on the spring unit, with uppers and / or fastening devices joined to this spring, sole and other parts of footwear,

**according to the invention,**

the pivot of the lower part of the spring in the spring unit is designed as a heel or heel and sole, or only the sole; outsole is made with the possibility to contact the supporting surface at the spring loaded;

fixing devices transferring gravitational effect on the spring of the spring unit includes an element made, for example, under the form of a cuff, partially or fully covering the user's leg (shin) and joined to the upper part of the spring as a stiff cover or another element supporting the leg, suspended on top of the spring in the form of elastic strip, connecting the upper part of the spring with a stiff cover, or other elements suspending the user's legs, or a combination thereof;

H1> H2 when there is no load applied to the spring, H1 = H2 or H1 is close to H2, when the spring is under the load, where

H1 - the distance between the ends of the spring;

H2 - the distance between the top of the spring and the bottommost of the foot.

**[0023]** Besides, the outsole of the gravity footwear may be joined to the spring to transfer the complementary gravity load on the spring, where H1> H3≥ H2, when there is no load applied to the spring and H3 means the distance between the top of the spring (the point of suspension of the leg) and the point of fixation of the sole. H1 = H2 = H3. Or H1 and H3 are close to H2 when the spring is compressed.

**[0024]** Spring unit may include several springs located in its back, on its sides or in the front of the shoe when the supporting element in the form of a heel is fabricated all-in-one-piece with all or several springs and the number of upper and below springs may not necessarily match.

**[0025]** The bottom rear part of the shoe when the spring is compressed may be located in the area of the user's heel.

**[0026]** The bottom rear part of the shoe when the spring is compressed may fit closely the sole. The sole when the spring is free of load may fit closely to the bottom rear part of the shoe and be joined to it.

**[0027]** The spring can have various shapes, e.g., it may be bow-shaped, bow-shaped with an additional curve designed to fit the user's heel. It may have half-ellipsoidal shape (flattened) etc.

**[0028]** The spring can have various cross-sectional shapes. It can be sickle-shaped, oblong isosceles triangle shaped section, oblong ellipsoidal shaped section, rectangle, U-shaped element, etc.

**[0029]** The cross-section and the longitudinal section of the spring may be constant or variable.

**[0030]** Material, his physical and technical properties of the spring may be constant or variable in length, width and thickness.

**[0031]** The spring may be partially or entirely made out of one or several materials: polymers, including polyurethanes, polycarbonates, and others, composites, elastomers, etc.

**[0032]** The upper part of a shoe includes a coat that covers the spring in its part or entirely. The latter may be joined to the upper part ensuring the possibility to change the angle of the spring, e.g. by fabricating the upper part corrugated or made out in the shape of a set of coherent and extensible elements.

**[0033]** The specified objective may be met by means of another type of gravity footwear, such as a shoe, boot etc., which accumulates energy, exerted by deflection and including:

**[0034]** The spring unit comprising at least one spring of the given value of flexibility, deflecting

**[0035]** From its free state to a compressed one, formed by footwear elements, where the bottom part of the spring is the supporting element, designed to contact with supporting surface;

**[0036]** Foot fixing device of the upper part of a shoe that communicate gravitational effect on the spring of the spring unit, when the upper part of a shoe and/or fixing device are joined to the said spring, sole and other parts of a shoe,

**according to the invention,**

pivot of the lower part of a spring of the spring unit is designed as a heel or a heel and a sole, or a sole only;

the outsole is fabricated with the possibility of contact with supporting surface when load is applied to the spring;

fixing devices to communicate gravitational effect on the spring of the spring unit includes a spring element made out, e.g., under the form of a cuff, partially or fully embracing the user's leg (shin) and joined to a upper part of the spring as a stiff cover or other element supporting the user's leg, suspended on top of the spring in the form of elastic strip joining the upper part of the spring to a stiff cover or another element suspending user's leg, or a combination thereof;

H1> H2 when there is no load applied to the spring, H1 = H2 or H1 is close to H2, when the spring is under the load, where

H1 - the distance between the ends of the spring;

H2 - the distance between the top of the spring and the bottommost of the foot.

**[0037]** The spring is provided with a spring-lock to fix it in a compressed state and a braking device that release spring-lock fixation when it is necessary, e.g. prior to perform pushing legs away from the supporting surface.

**[0038]** The said objective may be met by means of the

spring unit comprising at least one flexure spring of the given flexibility, deflecting from the initial state to a compressed one, when the lower part of the spring is a supporting element, intended to contact the supporting surface; fixing device to communicate gravitational effect on the spring within spring unit;

**wherein, according the invention,** pivot of the lower part of the spring within the spring unit is fabricated as a heel or heel and a sole, or a sole only;

fixing devices intended to transfer o gravitational effect on the spring within the spring unit includes an element made out, for example, in the form of a cuff, partially or fully embracing the user's leg (shin) and joined the upper part of the spring as a stiff cover or another soft support to be used in the user's shoe, suspended on top of the spring in the form of an elastic strip that joins the upper part of the spring with a stiff cover or another soft element suspending user's shoe, or a combination thereof;

H1> H2 when there is no load applied to the spring, H1 = H2 or H1 is close to H2, when the spring is under the load, where

H1 - the distance between the ends of the spring;

H2 - the distance between the top of the spring and the bottommost of the foot.

**[0039]** The claimed gravity footwear is featured by the flexure spring which constitutes basic shoe elements, e.g. a counter or a part of the counter, side elements, the heel etc, when the sole commonly remains traditional and it is not provided with a spring (although some options may provide a sole that represents an element of the lower part of the spring) and the heel (part of the spring) represents together with the sole a support to contact the surface.

**[0040]** In most fabrications the heel is directly joined to the sole. But when the spring is compressed, the user's heel along with the outsole may base upon the lower part of the spring heel. Several fabrications provide the lower supporting part of the spring made out in the form of the heel fitted to the sole or in form of the sole only. One of the options provides that during deformation of the spring the heel may come closer to the outer side of the sole and even join it.

**[0041]** The main benefit of the sprig unit featured by its ability to be used as a device, which fits into an ordinary shoe, is the fact that the user gets opportunity to accumulate energy disbursed by the flexure spring, the lower part of which is in most cases a heel (supporting part) and the upper part gets gravity load of the user's mass, and to use this energy to facilitate displacement. Besides, the displacement as well as it provided by the claimed footwear, may occur in ordinary way by means of engagement not only of the supporting end of the spring but of the footwear sole also.

**[0042]** Thus, the principle of accumulation and release of energy in the claimed footwear and in a spring unit seems similar to the principle of removable devices for improvement of jumping and racing: the bow-shaped spring gets deformed under the user's mass, accumulating energy, and then, when it is released it transfers energy to a user, pushing his/her feet forward and upward.

**[0043]** However, the user's foot is not engaged into displacement when using such devices.

**[0044]** The foot rests passively on the support that does not even contact the supporting surface.

**[0045]** In the claimed gravitational footwear by means of:

- the implementation of the spring in the form of footwear elements (counter, heel and other elements that are an integral part of the shoe) or the use of additional springs, which do not excess the traditional footwear,
- ensuring "soft suspension" of a foot in gravity footwear in the absence of contact of a shoe with the supporting surface (on the cuff and / or in the cover, etc.)
- compression of the spring under contact of the supporting element of the spring - usually the heel (combination "heel and sole", or a sole only is possible) with the support surface by means of transferring of gravitational effect on the upper part of the spring and/or on the lower part of the spring before the heel by the impact (supporting) of user's heel and/or of transferring of gravitational effect directly on the bottom rear part to which the sole is joined.
- supporting of the foot on the supporting surface when preparing to do the next step not only on the spring (heel), but also on the soles of a shoe,

as well as by means of providing opportunity to fix the compressed spring for conservation of its stored energy up to the repulsion of a foot away from the ground is ensured by the solution of the problem - increase effective use of the gravitational effect, as well as facilitating the movement due to the preemptive use of the traditional nature of movement from heel to toe, not just running or jumps, but a normal pace. This applies to the spring unit.

**[0046]** Footwear and the spring unit can officinal or homemade. Therefore, they meet the criterion of "industrial applicability"

**[0047]** The gist of the invention is illustrated by Figures, which give the layout view of the main footwear options. Most of these Figures illustrate only the basic elements of footwear in order to facilitate understanding of the essence of the claimed objects, while the secondary (topmost of footwear, mount, etc.) are not shown; user's foot is shown in thin lines :

Figures 1 - gravity footwear with spring, located on the backside of a foot, the lower part of which is a heel, while as shown in Figure 1 the communication of gravity loading on the top end of the spring through the cuff and ob the lower part of the spring by the user's heel; Figure 16- communication of gravity loading on the top end of the spring through the cuff and a cover and on the lower part of the spring by

the user's heel, when the cover is joined to the sole;
Figure 1 B - communication of gravity load on the top end of the spring through the cuff and an suspending element joined to the cuff in the form of embracing strip and on the lower part of the spring by the user's heel; Figure 1 Γ - communication of gravity load on the top of the spring through the cuff and a cover, partially covering user's foot and on the lower part of the spring by user's foot;
Figures 2 - gravity footwear furnished with spring, located on the backside of a foot, the lower part of which is a heel, and with a sole, joined to the lower part of the spring in the forepart of the heel: Figure 2a - communication of gravity loading on the top end of the spring through the cuff; Figure 2 b- communication of the gravity loading on the top of the spring through the cover, entirely covering user's foot;
Figure 3 - gravity footwear furnished with a spring, located on the backside of the user's foot, the lower part of which is a heel, and the middle part has a complementary curved part. Communication of gravity load on the top of the spring through the cuff;
Figures 4 - gravity footwear furnished with two springs, fixed on sides, enveloping user's foot on the sides and exceeding user's heel in the form of complementary curved parts, protruding supporting elements of the spring in the form of heels: Figure 4a - communication of gravity loading on the top of the spring through the cuff and suspension element in the form of foot embracing strip joined to the cuff; 4b - communication of gravity loading on the top of the spring through the narrow cuff and the joined cover, partially covering user's foot;
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Figure 5 - gravity footwear furnished with two bow-shaped springs embracing user's foot, fixed on the foreside of a shoe and exceeding user's heel, the lower part of which is the heel, the communication of gravity load on the top of the spring through the cuff and a joined cover, partially covering user's foot;
Figures 6 - gravity footwear furnished with two L-shaped springs going on the sides of the user's foot, the lower part of which is a heel: Figure. 6a-communication of gravity load on the top of the spring fixed on the front side through the cuff, and Figure 6 b - side view and back view, springs are joined to each other at the bottom, communication of gravity load on the top of the spring fixed on the sides through the cuff and a joined cover, partially covering user's foot;
Figures 7 - gravity footwear furnished with several springs, located on the backside and on the sides, the lower parts of which are protruding supporting elements in the form of heels: Figure 7a - communication of gravity load on the top of the spring through the cuff; 7b - communication of gravity load on the top of the spring through the cuff and a joined cover, partially covering user's foot;
Figures 8 - gravity footwear represented by a male shoe furnished with a spring located at the back of the user's foot, the lower part of which is joined to the sole (wide black line): Figure 8a - communication of gravity load on the top of the spring through the cuff, and Figure 8 b - communication of gravity load on the top of the spring through the cuff and a cover partially covering user's foot; 8c - communication of gravity load on the top of the spring through the cuff and a joined suspending element in the form of a strip embracing user's foot;
Figure 9 - gravity footwear represented by a male shoe with its topmost covering user's (see the outline of the topmost) furnished with a spring located on the backside of the user's foot, the lower part of which is joined to the sole (heel);
Figure 10 - gravity footwear represented by a male shoe with its topmost embracing user's foot furnished with two bow-shaped springs, located on the sides, the lower part of which is joined to the with sole (heel);
Figures 11 - gravity footwear furnished with spring locator and the topmost embracing user's foot: Figure 11a - spring is located on the backside of the user's foot, the lower part of the spring is joined to a heel and a sole element, the communication of gravity load on the top of the spring through the cuff and a cover partially covering user's foot; Figure 11b - two springs located on the sides, communication of gravity load on the top of the spring through the cuff and a cover partially covering user's foot;
Figures 12 - gravity footwear represented by a women's shoe: Figure 12a - spring is located on the backside of the user's foot, the lower part of the spring is a heel, communication of gravity load on the top of the spring through the cuff and a cover, Figure 12b - spring is located on the backside of the user's foot, the lower part of the spring is a heel, the spring is joined to a sole, communication of gravity load on the top of the spring through the cuff, Figure 12c - two lateral springs, the lower part of the spring represents is a sole/ heel, the end is turned backwards, the communication of gravity load on the top of the springs through the cuff, and Figure 12d - two lateral springs, the lower part of each spring is a heel, turned backwards, the spring is joined to the sole, transfer gravity load on the top of the spring through the cuff, Figure 12 e - two springs, embracing user's foot on each side, the lower part of each spring is a support (the heel is combined with a sole), the spring is additionally equipped with a support for the heel, the communication of gravity load on the top of the springs fixed on the foreside through the cuff , 12e - 12f version, footwear represented by ballet shoes;
in Figures 13 - gravity footwear with a spring, located on the backside of the user's foot, the lower part of which or is a heel with the adjacent or sole joined to it, either the sole only, Figure 13a - communication

of gravity load on the top of the spring through the cuff; Figure 13b - transfer gravity load on the top of the spring through the cuffs and a cover, covering user's foot;

Figure 14 - layout of the spring unit to be used with normal shoes;

Figure 15 - gravity footwear with a spring, located on the backside of the user's foot and divided below into two elastic spring elements arranged at an angle to each other: the heel and sole getting thick at the end;

Figure 16 - gravity footwear, similar to the described in Figure 15, with difference that it is designed with the space between the sole and heel, filled with easily deformable material, such as a porous material;

Figure 17 - gravity footwear furnished with two springs located on each side whose ends are joined to the elastic sole;

Figure 18 - cross sectional embodiments of the spring;

Figure 19 - options of women's sandals with a cuff, different supporting elements and the spring, embracing the backside of the user's foot. The lower part of the spring is a heel of the C-shaped cross-section;

Figure 20 - layout of women's sandal with side L-shaped springs in different phases of loading: phase 1 - foot doesn't rest, the heel appears below the sole, phase 2 - foot rests, the spring is compressed (curved), the heel levels the foot;

Figure 21 - the best embodiment of a cuff and a cover (side view and backside view);

Figure 22 - spring unit with two springs located on each side, whose ends are connected by the under-heel element going below the backside of the sole of an ordinary shoe;

Figure 23 - layout of women's sandal with a variable cross-sectional spring, embracing the lower part of the user's foot on the backside, the sole being joined to the spring.

**[0048]** The claimed gravity footwear may appear in the form of a shoe, a boot or a high boot, a sandal etc., including as a mandatory element, at least one flexure spring of the given flexibility, deflected from the initial state to a compressed one and exerting energy on pushing user's foot when it is released or acceleration due to synergetic effect when the foot would roll from heel to toe. The said spring 1 in the claimed shoe or is joined to traditional shoe elements, e.g. bottom rear part or a heel, either it is a pat thereof, either a complementary inside or outside shoe element. For example, the upper part of the spring can embrace user's foot, but at the same time it can go inside a shoe, be sewn into a shoe or be attached from the top of a shoe (Figures 9, 10, 11).

**[0049]** The lower part of the spring is a supporting element contacting the surface that a user is going on. The most embodiments of the claimed footwear the said supporting element is designed as a high heel 2 (Figures 1-7, 12, etc.) or a low heel 2 (Figures 9, 10, 11). However, embodiments of a support element of spring in the form of heel and sole, and in the form of sole only (Figure 13a and 13b) are possible.

**[0050]** This description does not use the term "shoulder of the springs", though every used spring normally includes two shoulders on opposite sides of the deflection curve.

**[0051]** The claimed gravity footwear, apart from the said above spring 1, includes the usual elements for the appropriate shoes: sole 3, topmost 4 etc.

**[0052]** The topmost 4 of a shoe ensures protection of the user's foot from adverse impacts fixes the position of the user's foot and provides opportunity for regular curving of spring 1 without damages to topmost elements 4. The said topmost 4 includes fixing devices to fix user's foot, the topmost 4 and fixing devices are joined by the said spring 1, sole 3 and other shoe elements. The said fixing devices can be stiff part of the topmost of a shoe, e.g. stiff strips etc., and/or fixing elements, e.g., belts, strips, laces, coats, Velcro, zippers etc.

**[0053]** In separate options the topmost of a shoe can represent only a fixing device, e.g. wherein sandals are the embodiment of such shoe (Figure 19).

**[0054]** The said topmost 4 of the shoe furnished with fixing devices apart from fixing of the user's foot and its protection against environmental impacts must provide the communication of gravity action from user's body mass on spring 1, therefore special elements are designed in the claimed footwear. The form of its embodiment can be different.

**[0055]** One of the options provides cuff 5 partially or entirely embracing user's leg (shin) and joined to the top of spring 1 to transfer gravity action on the top of the spring. In this case, cuff 5 may be joined to spring 1 in a small section (Figures 2a, 2b), or in a lengthened (along the legs) section (Figures 1, 3). In the first case the pin load id applied to spring, in the second case, the load is distributed along the length of cuff 5.

**[0056]** The cuff can be made in the form of a relatively narrow elastic ring or semi-ring (Figures 1d, 2b, 4b, 7b, 8a, 8b, 8c, 13b). There can be a several number of such rings (not shown in Figures). There can also be other, not considered herein options of application of relatively pin or distributed gravity load to the upper part of spring 1.

**[0057]** Cuff (ring) 5 performs function of load transferring to the top of the spring from a shin, therein the user's foot hangs down in the cuff due to thickening of the shin, to the firm embracing of the shin by the cuff (clip), or due to the both, thickening and firm embracing at once.

**[0058]** When the spring is free (no support on ground) and when the supporting element of the spring contacts with ground the user's foot is hanged in the said cuff 5, although the heel can touch the lower part of spring 1 (Figures 1d, 4a). When a supporting element (the lower part of spring, heel) rests on the ground gravity load is communicated from the user's body mass through cuff 5, or other items to spring 1.

**[0059]** In high footwear (boots) cuff 5 may be placed under the knee, in high shoes - on the shin. In a shoe or a sneaker cuff 5 may be placed above or below the ankle. The topmost of a shoe may serve as cuff 5. The width of cuff 5 may vary over a wide range; inter alia cuff 5 may embrace the entire upper part of a shoe, for example, up the ankles.

**[0060]** Cuff 5 may be joined to spring 1 only in its upper part (pin load), or along the entire height of the cuff, or at the height of the cuff (distributed load).

**[0061]** An another embodiment provides stiff cover 6 and another soft element, supporting use's foot, hung to the upper part of spring 1 to transfer gravity action to the upper part of spring. In this case, application of load to spring 1 can by pin (cover 6 joined to spring 1 in a small area) or distributed at several length of spring, e.g. through elastic strip going from top and downward, joining spring 1 to cover 6 e.g. in the right and in the left of spring.

**[0062]** Cover 6 can completely (Figures 2b, 12a) or partially (Figures 1d, 5, 8b, etc.) cover the user's foot. Partial coverage of the user's foot (suspension) can be provided by using strip 7 *(Figures* **1c**, 4a, 9).The embodiment of cover **6**, partially covering user's foot and providing free bending of a footstep, as shown in Figure 21 seems fit the best.

**[0063]** The upper part of cover 6 can be circumferentially joined to cuff 5, providing uniform application of gravity load from the cover to the cuff, although the use of tough material as a cover allows to retreat from cuff 5 and to suspend cover 6 directly to the upper part of spring 1. The fixation of cover 6 to cuff 5 or spring 1 can be performed by any known means.

**[0064]** The following options of shared use of cuff 5, cover 6, or strip 7:

- cuff (elastic ring or semi-ring) 5 and cover 6 (Figures 1b, 2b, 8b, 12a, 13b);
- cuff 5 and strip 7 (Figure 4a);
- cuff 5, cover 6, and strip 7 (Figures 1c, 8c).

**[0065]** One of the conditions defining the efficiency of gravity footwear is a necessity to ensure the primary support of a foot with communication through it, of *gravitational effect* on the pivot of spring 1. Under this condition, spring 1 shall be compressed properly and able to accumulate the maximum amount of energy. While user's foot does not rest on ground, it remains "hung" in the cuff is 5 or cover 6 or in strip 7 on the top of flexure spring. When lowering a foot up to contact of a heel 2 with the ground, due to gravitational effect of the user's body mass on the spring, the latter is deformed (bent) and the foot gradually descends and starts resting on the ground by heel 2 and sole 3.

**[0066]** With this regard the relation: H1> H2 must be met when there is no load applied to the spring, wherein H1 - distance between the ends of the spring;
H2 - distance from the top of the spring to the bottom of the foot.

**[0067]** When spring is loaded H1 = H2 or gets closer to H2.

**[0068]** The greater is the difference between these values, the more the spring is bent (compressed) and the greater shall be pushing or sliding effect.Perhaps the indicated difference between H1 and H2 or limited by the shape of a shoe and conditions of its serviceability. With user's foot rests on the ground by way of flexure of spring 1, the distance between two ends of the compressed spring is equal to or close to H2

**[0069]** Spring can be joined to cuff or cover at any point on the circumference of the user's foot (footwear topmost), for example on the backside (Figures 1a, 1b, 1c, 1d, 2a, 2b, 3, 8a, 8b, 8c, 9, 12a, 12b, 13a, 13b), on the sides (4a, 4b, 6b, 7a, 7b, 10, 11b, 12c) or in the forepart (Figures 5, 6a, 12e, 12f).

**[0070]** If there are two springs, they can be symmetrical.

**[0071]** Springs can embrace user's foot on the backside (Figures 1a, 1b, 1c, 1d, 2a, 2b, 3, 8a, 8b, 8c, 9, 12a, 12b, 13a, 13b), be located on the sides (Figures 4a, 4b, 6a, 12d, 12e, 12f), or pass from the forepart to the backside of a shoe (Figures 5, 22), pass from the sides to the backside of the shoe (Figure 4a, 4b, 6b, 10, 12c) and etc.

**[0072]** The spring can be mounted anywhere on the circumference of user's shin and still be only one.

**[0073]** In the case of lateral springs, the latter may be joined by sub-heel element 8, through which can be spring 1 can accommodate load. This sub-heel element 8 may pass into the pivot (heel) 2 volumes, uniting lower parts of springs, but may be represented by a separate saddle-shaped joining element between the supporting parts of springs (Figure 6b).

**[0074]** Spring 1 can be made out of one or more materials: e.g., polymers (polyurethane, polycarbonate, etc.), composites, elastomers and other elastic materials, while separate elements of spring 1 can be made of out of different materials, e.g., the main part of the spring can be made out of composite material, possessing the required high elastic properties (stiffness) at high flexural strength, when heel 2 can be made out of less expensive, but high wear-resistant material.

**[0075]** The cross section of spring 1 may be different. Some cross section embodiments are shown in Figure 18 (user's foot is located on the right side of the section that means it is covered by the spring spring). For example, as it is shown in Figure 18a, the section is a highly elongated at the base of an isosceles triangle with slightly concave base; in Figure 18b - a triangle with a strongly concave base, and in Figure 18c - a rectangle with a strongly concave base, and Figure 18d - an elongated rectangle with a slightly concave base, and Figure 18 e - C-shaped section, Figure 18f - section of three springs, embracing user's foot.

**[0076]** The cross section of a spring can be constant over the length or alternate. For example, the spring, located on the backside of a foot, has a C-shaped cross

section (partially embracing, envelope) on top, and slip into a striped heel being circle-shaped in its low part. Two lateral springs with rectangular cross-section can be combined to form a common rectangular or mid-S-shaped section at the bottom of the spring.

**[0077]** Elastic properties of a spring may be constant or variable in length and thickness of the springs, e.g., material of heel 2 may be stiffer than the rest of the spring.

**[0078]** The form of spring 1 can be different:

- simple arch-shaped (bow-shaped) (Fig. 1a-d, 2a-b, 12b);
- bow with additional curved sections, such as a sub-heel section (Figure 3, 4a-b, 5);
- L-shaped (Figures 6a, 6b, 20);
- C-shaped, oblate-shaped in the form of a semi-ellipse (Figures 9, 10, 12c)
- bow with additional deviating elements, representing a sole or another supporting element (Figures 12b, 12d, 12f).

**[0079]** The notion of "spring" mentioned in the claimed gravity footwear is no limited by a single spring. There may be more. The upper part of spring 1 can be located on the backside of a shoe, especially if the only one spring has been used. Other embodiment provide multiple (two and more) springs embracing user's foot on the sides (Figures 4a, 4 b, 5, 6a, 6 b, 10, 11 b, 12 c, 12 d, 12 e, 12f) or go along the backside and sides of the user's foot (7a, 7 b). Several springs can be joined to each other, as for example, in the area of a supporting element (heel or sole). In this case, each of the springs may have one top and two or more lower parts and vice versa. However, the given illustrations do not cover all possible options, both in the number of springs used and their possible location.

**[0080]** In the traditional smooth bow-shaped spring 1 flexure is mostly provided by affecting the upper part of spring 1, with resting of heel 2 on the supporting surface, e.g. on the ground.

**[0081]** However, the communication of gravity load on the lower part of spring 1 is possible from the impact born by user's heel to the heel 2, resting on the supporting surface. In this type of loading spring may be fitted with a special projection from under the heel, though the heel may rest upon smoothly bent bow (excluding projection).

**[0082]** When the form of a spring is complicated, e.g., when it is bow-shaped with additional flexure (projection), running user's heel's contour, communication of gravity forces may be performed on the top of spring 1 and further through heel 2 on the supporting surface, as well as through the additional support of a heel (additional flexure, projection) on the lower par of the spring.

**[0083]** The height of heel 2, being the lower part, flexure spring 1 may be different.

**[0084]** In women's shoe heels may be high enough, e.g. 5-7 cm or more. The best of all such kind of heel is shown in Figures 12a, b, c, d and Figures 19, 20.

**[0085]** In men's and sport's shoe the height of a heel can be less, e.g., 1-3 cm (Figures 9, 10).

**[0086]** Several embodiments provides heel, which is as in case of any other types of footwear, a support for user's heel, it does not extend the bottom surface of the sole (Figures 8a, b, c,). In these embodiments the lower end 2 of spring 1 partially embraces user's heel (acts as a supporting element under user's heel, which means it is a kind of a heel) and is joined with sole 3. The loading of the upper part of such spring can be performed with help of cuff 5 and / or cover 6 and / or embracing strip 7. While H1> H2, the foot is suspended, there is a gap between sole 3 and the user's foot. When the spring is bending the foot rests on sole 3 and the lower end of spring 1.

**[0087]** It is also proposed an option of footwear furnish with folding heel 2 (moving close to the sole until the complete joining it). In this case, when the *gravitational effect* are communicated to the spring, heel 2 gradually bends and comes close to sole 3 (Figures 2a and 2 b). When rolling heel-to-toe the sole in its turn can comes close to the heel.

**[0088]** In the lower part the spring can divide in to spring elements located at an angle to each other: the heel and the sole (Figures. 15 and 16). This embodiment shall allow first, to increase the efficiency of energy storage (two springs), and second, to prevent its inappropriate use due to the communication of energy from the heel to the sole when the heel starts separating the support (the necessity of a fixing device is excluded) third, to accelerate the rolling from heel to toe. As it is shown in Figure 16, space between the heel and the sole is filled with easily deformable material, e.g., such as porosity, which shall eliminate the entry of extraneous bodies between the springs (stones, dirt, etc.).

**[0089]** Figure 17 shows the embodiment of a shoe (or the spring unit), in which springs, embracing user's foot, are joined to the sole, which is spring too. This shall allow to facilitate and to accelerate the process of rolling from heel to toe.

**[0090]** The option, when the role of supporting element is performed by the heel, combined or joined to the sole or pivot of the spring is a whole sole or a part o it (Figures 13a, b). If latter, its length can be equal or excess the length of the user's foot, and the movement is pperformed by initial rolling from heel to toe (to the end of spring 1).

**[0091]** The shoe topmost 4, apart from obligatory elements, may an outer coat, which covers spring 1, or adjoins the spring, or passes under the spring and provide possibility of its periodic flexure. This coat can be corrugated or consist of separate adjoined or overlaying ring-shaped elements. The coat can partially or entirely cover user's foot.

**[0092]** Besides, the shoe topmost 4 may include an internal part, directly adjacent to the foot (lining). The inner part may be not joined to spring 1 and be not subjected to deformation at flexure. In the latter instance, the requirements to the materials are common. If the inner part is joined with the upper part of spring 1, the material

and / or internal design should enable its deformation when the spring is compressed.

**[0093]** Sole 3 can fit the shape of an ordinary shoe and ensure a comfortable accommodation of a foot, foot protection from mechanical damages. The sole (its lower surface), as in other kinds of footwear, must be sufficiently durable.

**[0094]** Sole 3 may be joined with the lower part of spring 1 to provide additional communication of compressive forces from a foot to the spring. The junction can be accomplished, for example, as a swivel joint, which provides possibility of bevel of the forepart of sole 3 downward to the supporting surface. At the same time, sole 3 in its initial position, is located horizontally, and when walking the sole forepart is beveled to support foot and roll from heel to toe and push.

**[0095]** According to an embodiment, the foot may immediately adjacent to the sole 3 (without gap) which doe not rest on the ground. Since the beginning of supporting to the ground, gravitational forces are distributed and affect the upper part of the spring through the cuff and the lower part of the spring by user's heel through the backside of the sole or only the lower part of the spring (Figures 1 b, 1 c).

**[0096]** According to another embodiment a foot in its initial position does not adjacent the sole 3, that doe not rest on the ground (supporting surface), a gap remains between them (Figures 2a, b, 8a, b, c, 12b, d), and the following relation H1cooTHOIIIeHe is maintained, where H3 is the distance from the top of the spring (the point of foot suspension) to the point of attachment of the sole. When spring 1 bends, the gap between the foot and the sole is selected first, and then comes the gap between the sole and the support. This solution provides greater difference between H1 and H2 when there is no applied to the spring.

**[0097]** Spring 1 can be equipped with fixing device 10; clamping spring 1 when it is compressed and liberating the spring in a given moment, such as when the user pushes his foot away from the supporting surface (makes the next step). It is necessary for that the stored energy would not be wasted when rolling foot from heel to toe, because when the spring separates the support during time period, exceeding the return of the spring to its initial state, energy shall be lost.

**[0098]** Any embodiment of fixing device 10 and release device know by present technology is possible. In this way Figures 11a and 11b show one of possible mechanical devices: hook-shaped fixing device 10 locks spring 1 and get released under action of a foot on the draw bar 11

**[0099]** An option of self-fixing spring, equipped with hooky grips ("Velcro"-type), joined at spring flexure to adjacent element of a shoe. Forced release of a spring is possible changing user's shin slope angle, which happens when a user is ready to separate his/her foot from the support (rolling).

**[0100]** Options of fixing device 10 shown in Figures do not necessarily exhaust all embodiments. Fixing device 10 may be magnetic or made on basis of electronic devices. The key condition is that the moment of fixation should meet maximum deformation of a spring, and its release should meet the moment of pushing user's foot away from supporting surface.

**[0101]** Figure 12 d shows women's shoes, whose sol is joined to the spring, while the rear part of the sole project beyond the heel (bottom part of the spring) and serves as an additional support under user's heel. Similar structures are shown in Figures 12 e and 12 f. These options can be used with the greatest efficiency as ballet footwear.

**[0102]** Spring unit (Figures 14, 22) can be used as a device for an ordinary shoe, which accumulates gravity energy and provides opportunity of racing (jumping) as well as walking by rolling from heel to toe.

**[0103]** Spring unit is a device that by its design corresponds to a spring unit used to be fitted in the claimed gravity footwear. It comprises at least one spring 1 and a fixing device in the form of cuff 5 described hereinabove, embracing user's shin, or a soft stiff (non stretching) element 7 supporting the user's foot. The latter ensures a smooth suspending of the user's foot relative to the upper part of spring 1 and communication of gravitational effect on spring 1. The ratio of dimensions between the ends of spring 1 when there is no load applied (unloaded) H1 and distance

**[0104]** Spring unit is a device which basically corresponds by its design to the spring unit used in the claimed gravity footwear. It includes at least one spring 1 and spring attachment device as described above, cuff 5, covering the user's shin, or a a soft stiff (non stretching) element 7, supporting the user's foot, through which ensure ourselves to soft suspension legs the user to the top of the spring 1 and transmitted to the gravitational effect of a spring. Ratio between the ends of the spring 1 in the free (unloaded) state of the H1 and the distance from the point of suspension to the bottom of the soles of shoes 3 usually H2 is similar to the above-mu: H1> H2. During loading of the spring a distance call, then have a leg of the user begins to focus not only on the supporting end of the spring 1, but on the sole of three ordinary shoes.

**[0105]** Embodiment of the spring unit as a device is similar to the spring unit gravity footwear.

**[0106]** The claimed gravity footwear used as follows.

**[0107]** A user put the shoes on and fixes, if necessary, the position of his/her foot by means of special fixing device, e.g. fixes cuff 5 and sole 3 by belts.

**[0108]** After the shoes are put on, the user stands on supporting surface, then springs 1 are compressed, each foot rests on heel 2 and sole 3.

**[0109]** At the beginning of movement the user lift one foot while continuing to rest on another one. When one foot is lifted sprung one inside a shoe gets released and H1>H2, user's foot hangs in the upper part of spring 1: on cuff 5, in cover 6 or on strip 7. Then when moving ahead this foot touch the supporting surface by projected

supporting element of the spring, e.g. by the heel. Upon contact with the support, the user transfer a part of his body mass on that foot, compressing spring 1. The distance between the ends of spring 1 becomes equal to the distance from the point of suspension to the lower point of the user's foot H2 or comes close to it. Compressed spring 1 accumulates energy. When moving further user's foot rolls from heel to toe to push toe away from the support. If features of the spring are selected in such a manner that the spring deflects over a period of time, that exceeds time of rolling from heel to toe, energy of the spring is not lost and in the moment of separation of a toe away from the support it pushes user's foot towards and upwards. If the spring gets released quickly it would be wise to use complementary devices such as fixing device 10, which ensures compression of spring 1 up to the moment of spring repulsion. Fixing device 10 can be released under effect of the spring on special device, e.g. draw bar 11 joined to fixing device and furnished with a concaved section in the forepart beyond the spring. If you press on the concaved section the draw bar length11 gains and the draw bar pushes fixing hook 10 out of latch with spring 1.

**[0110]** In order to reduce losses of accumulated energy it is possible to use two springs and two supporting elements (lower parts, arms of spring), one of which is a heel, another one is a sole. This shall ensure energy savings wile rolling from heel (bottom rear part) to toe (sole), see Figures 15 and 16.

**[0111]** Spring unit operates in similar way as a complement to conventional shoes.

## Claims

1. Gravity footwear in the form of shoes, boots, etc. with the accumulation of energy caused by elastic deformation, including spring (1) unit comprising at least one flexure spring of given flexibility deflecting from the initial state to a compressed state, and formed by elements, wherein the lower part of the spring (1) is a supporting element, designed to contact the supporting surface and the upper part of the spring (1) is equipped with fixing devices to fix a position of the user's foot and communicate gravitational effect on a spring (1) of spring unit, where the upper part of the shoe and/or fixing devices are joined to the said spring, sole and other elements of the shoe, **characterized in that** the supporting element of the lower part of the spring (1) within the spring unit is made in the form of a heel (2) or a heel and a sole, the sole (3) is made with opportunity to contact with the supporting surface when the load is applied to the spring (1), fixing devices for communication of gravitational effect on the spring (1) within the spring unit comprise an element, made, e.g. in the form of a cuff, partially or entirely covering user's leg (shin) and joined to the upper part of the spring (1), in the form of a stiff cover or another element, supporting user's foot, suspended on the upper part of the spring (1), in the form of an elastic strip, joining the upper part of the spring to a stiff cover or another element suspending user's foot, or a combination thereof, wherein at the same time H1>H2 when there is no load applied to the spring (1) and H1=H2 or H1 comes close to h2 when the spring is loaded, whereas H 1 is the distance between the ends of the spring (1), H2 is the distance from the upper part of the spring (1) to the bottom part of the user's foot.

2. Gravity footwear according to claim 1, **characterized in that** the sole (3) of gravity shoes can be joined by the spring to communicate an additional gravitational load on it, wherein H1>H3≥H2 when there is no load applied to the spring (1), where H3 is the distance from the upper part of the spring (foot suspension point) to a point of sole fixation, H1=H2=H3 or H1 and H3 comes close to H2 when the spring (1) is compressed.

3. Gravity footwear according to claim 1, **characterized in that** the spring (1) unit comprises several springs (1), located as in the rear part of the shoe, as well as on its sides or in the forepart of the shoe, wherein the supporting element in the form of a heel can be made all-in-one-piece with all or several springs or be a part of several springs, wherein number of upper and lower parts of springs can not match.

4. Gravity footwear according to claim 1, **characterized in that** the heel is located when compressed spring is located in the area of user's heel (2).

5. Gravity footwear according to claim 1, **characterized in that** the heel when spring is compressed is adjacent to the shoe soles.

6. Gravity footwear according to claim 1, **characterized in that** the heel adjacent to the sole and joined to it.

7. Gravity footwear according to claim 1, **characterized in that** the spring has a simple bow-shaped (arc-shaped) form, or a bow-shaped form provided with an additional curve, placed, e.g., under user's heel; or semi-ellipsoidal (oblate) form etc.

8. Gravity footwear according to claim 1, **characterized in that** the cross-section of the spring (1) is crescent shaped, or have a shape of an elongated isosceles triangle, or a shape of a oblong ellipsoid or of a rectangle or be U-shaped.

9. Gravity footwear according to claim 1, **characterized in that** the cross-section and longitudinal sec-

tion of the spring (1) can be constant or variable.

**10.** Gravity footwear according to claim 1, **characterized in that** the spring material, its physical and technical properties are constant or variable in length, width and thickness.

**11.** Gravity footwear according to claim 1, **characterized in that** the spring is partially or entirely made out of one or more materials such as polymers, including polyurethane, polycarbonate, etc., composites, elastomers, etc.

**12.** Gravity footwear according to claim 1, **characterized in that** the upper part of the shoe includes a coat, which partially or completely covers the spring (1) or joined to it ensuring the opportunity of changing the angle of the spring (1), e.g., by making the topmost out of corrugated material or in the form of a set of coherent and extensible elements.

**13.** Gravity footwear in the form of a shoe, boot, etc. with the accumulation of energy caused by elastic deflection, including the spring unit containing, at least one flexure spring of the given flexibility, deflecting from initial state to a compressed state and formed by shoe elements, while the lower part of the spring is the lower element, designed to contact with the supporting surface, the upper part of the shoe equipped with fixing devices to fix a position of the user's foot and to communicate gravitational effect on the spring (1) within the spring unit, wherein the upper part of the shoe and / or fixing devices are joined to the said spring, sole and other parts of the shoe, **characterized in that** the supporting element of the lower part of the spring within the spring unit is made up in the form of a heel (2) or a sole or a sole only, the sole is designed with opportunity to contact with the supporting surface when the load is applied to the spring, wherein fixing devices, which communicate gravitational effect on the spring within the spring unit include an element made up, e.g. in the form of a cuff, partially or entirely covering the user's leg (shin) and joined to the upper part of the spring, in the form of a stiff cover or another element, supporting foot, suspended on the upper part of the spring, in the form of a flexible strip, joining the upper part of the spring to a stiff cover or another element, suspending the user's foot, or a combination thereof. At the same time H1=H2 or H1 comes close to H2, wherein H1 is the distance between the ends of the spring, H2 is the distance between the upper part of the spring and the lowest point of the user's foot, where the spring is equipped with a fixing device and a releasing device to get fixing device out of hookup, if necessary, e.g. before the repulsion of the user's foot away from the supporting surface.

**14.** Spring unit comprising at least one flexure spring of a given flexibility, deflecting from the initial state to a compressed state, while the lower part of the spring is a supporting element, which contacts with the supporting surface, and fixing devices, which communicate gravitational effect on the spring within the spring unit, **characterized in that** the supporting element of the lower part of the spring within the spring unit is designed as a heel or a heel (3) and a sole, or a sole only, fixing device, which communicates gravitational effect on the spring within the spring unit includes an element made up, e.g. in the form of a cuff, partially or entirely covering user's leg (shin) and joined to the upper part of the spring, in the form of a stiff cover or another soft supporting element for the user's shoe, suspended on top of the spring, in the form of a flexible strip, joining the upper part of the spring to a stiff cover or another soft element, which suspends the user's shoe or a combination thereof, wherein At the same time H1>H2 when there is no load applied to the spring and H1=H2 or H1 comes close to H2, wherein H1 is the distance between the ends of the spring, H2 is the distance between the top of the spring and the lowest point of the sole of user's shoe.

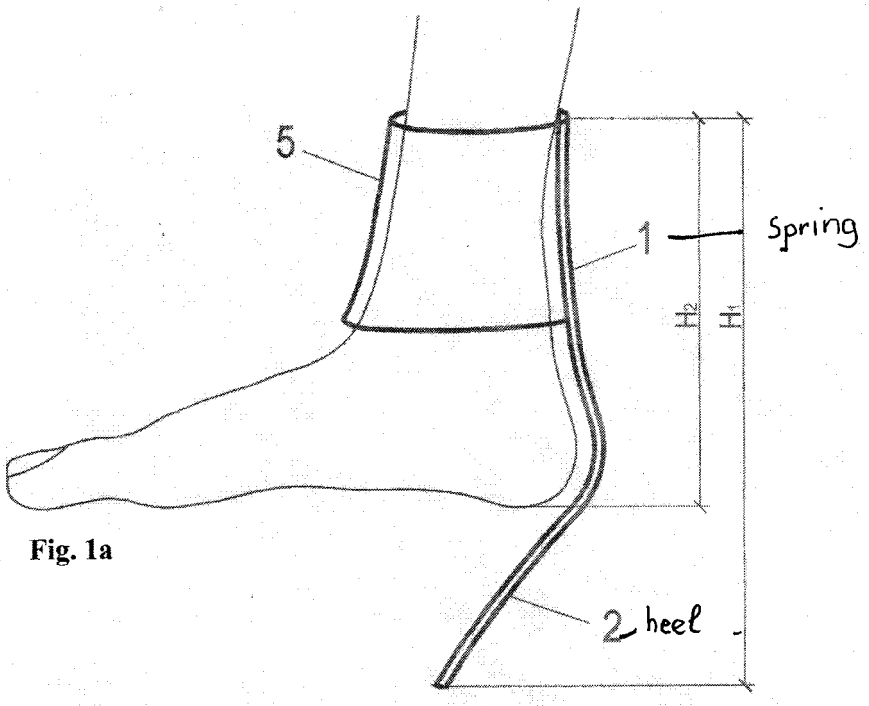



Fig. 1a

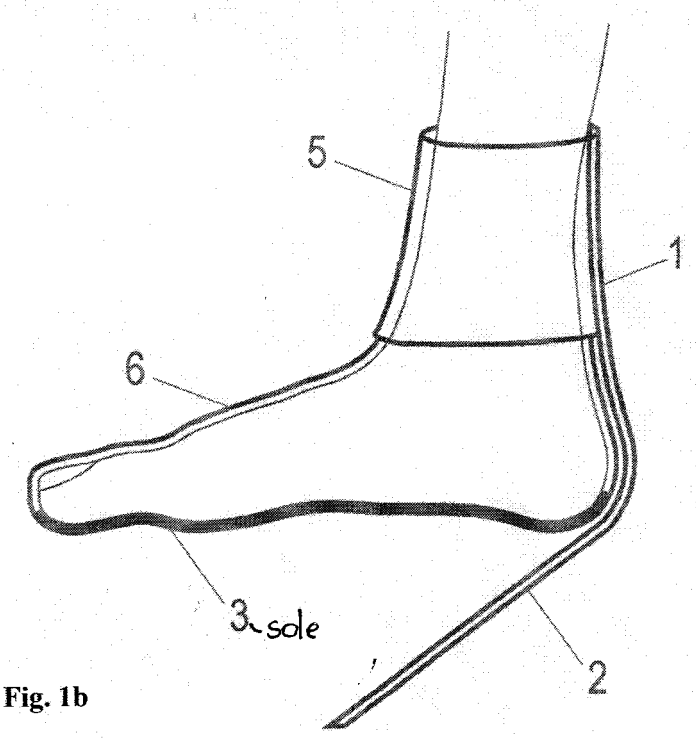



Fig. 1b

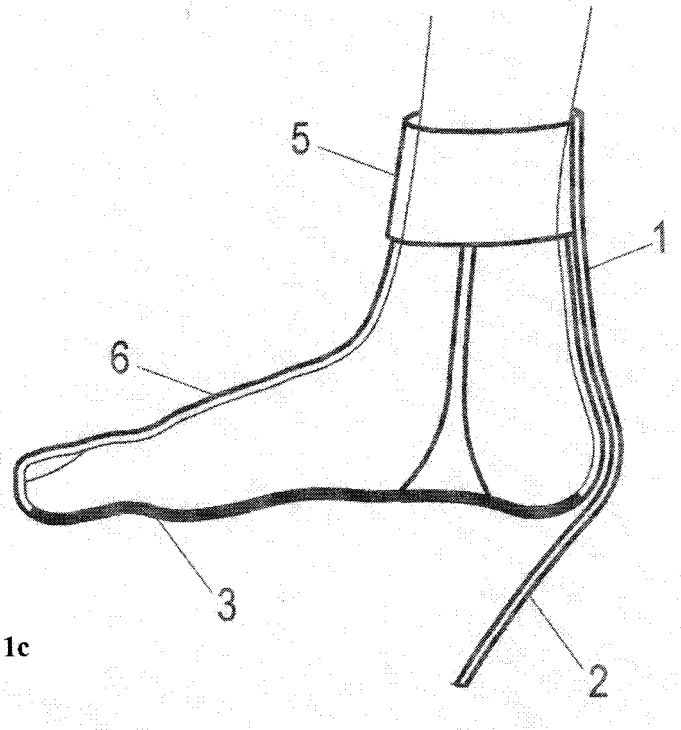



Fig. 1c

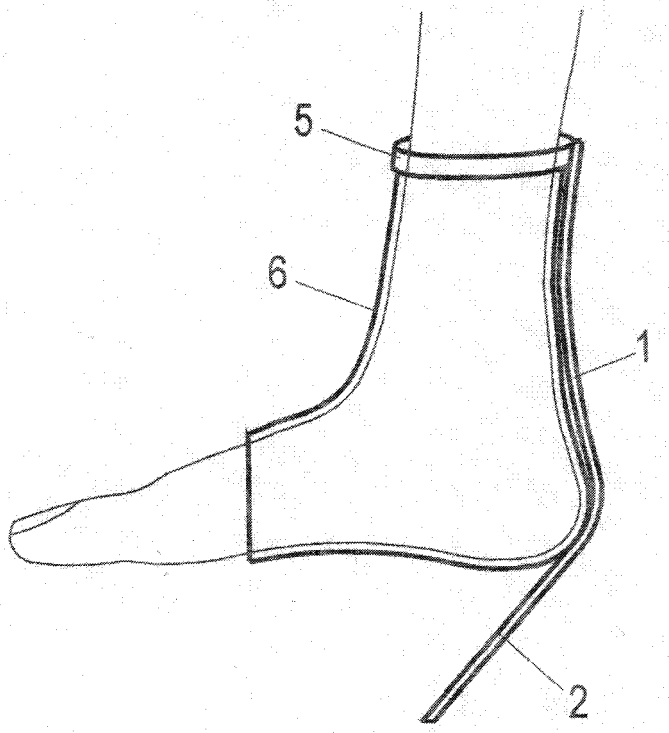



Fig. 1d

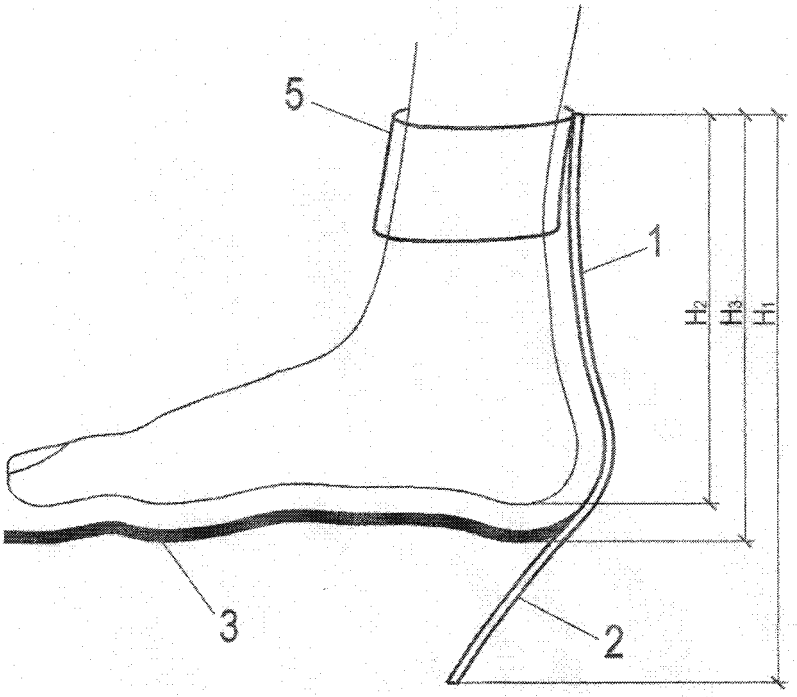



Fig. 2a

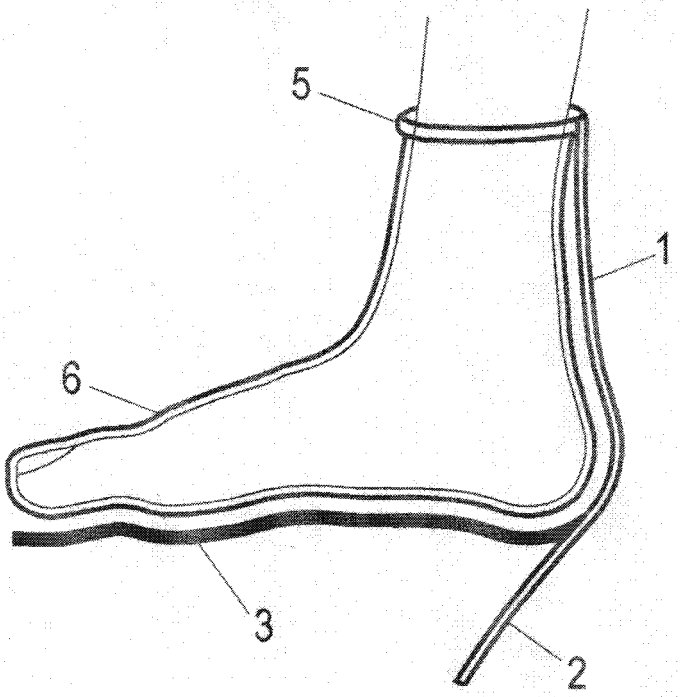



Fig. 2b

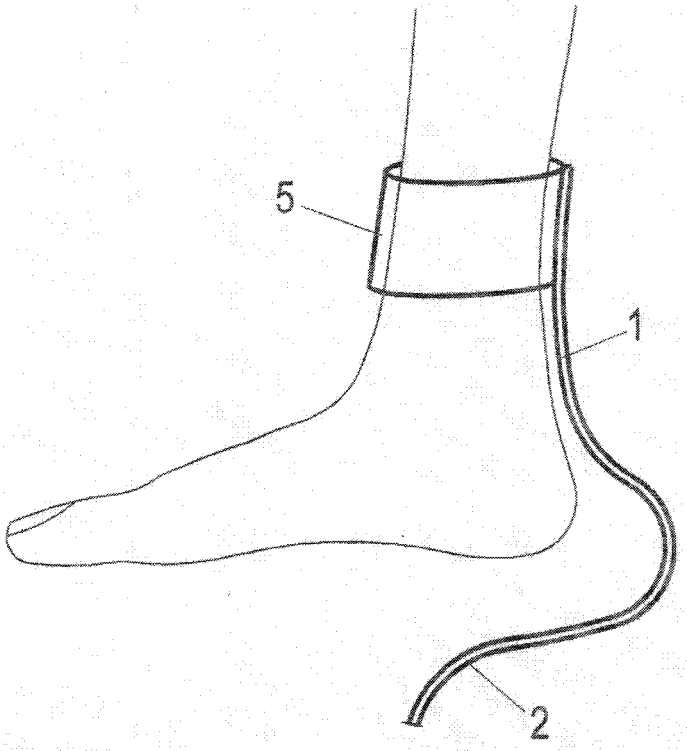



Fig. 3

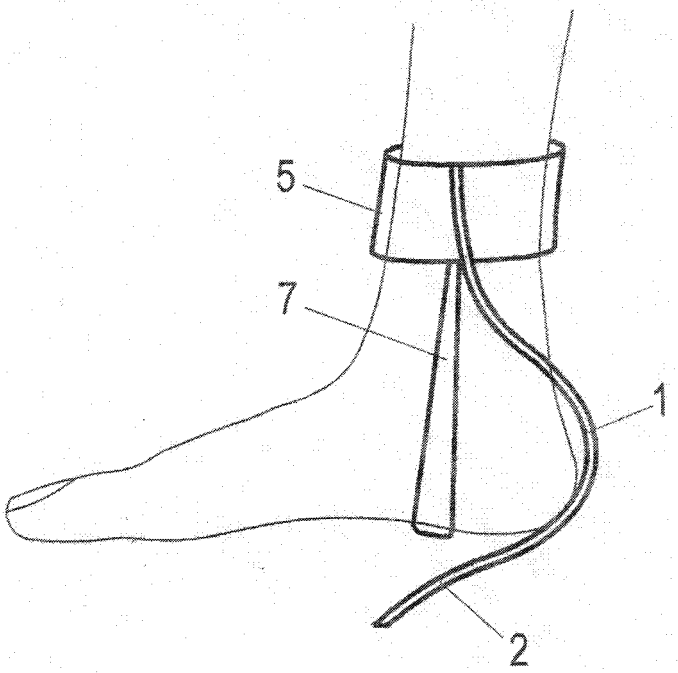



Fig. 4a

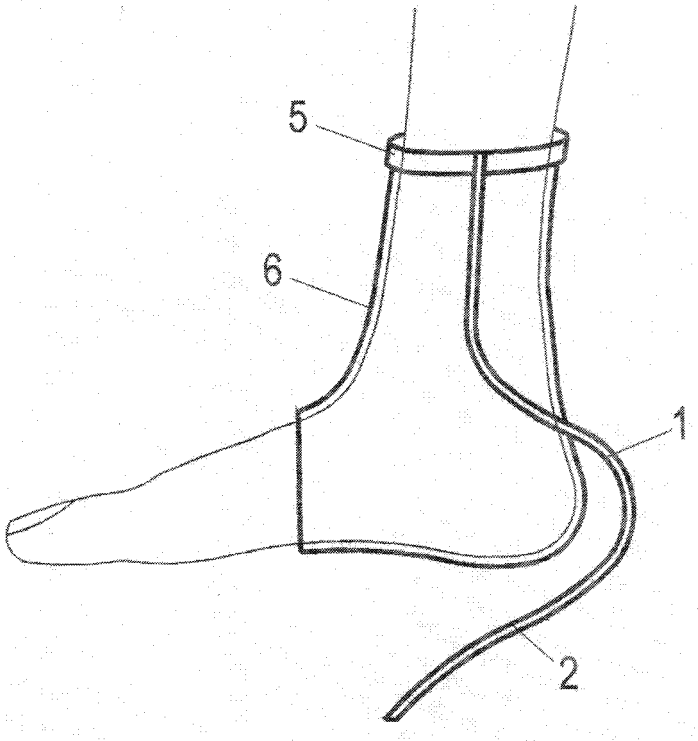
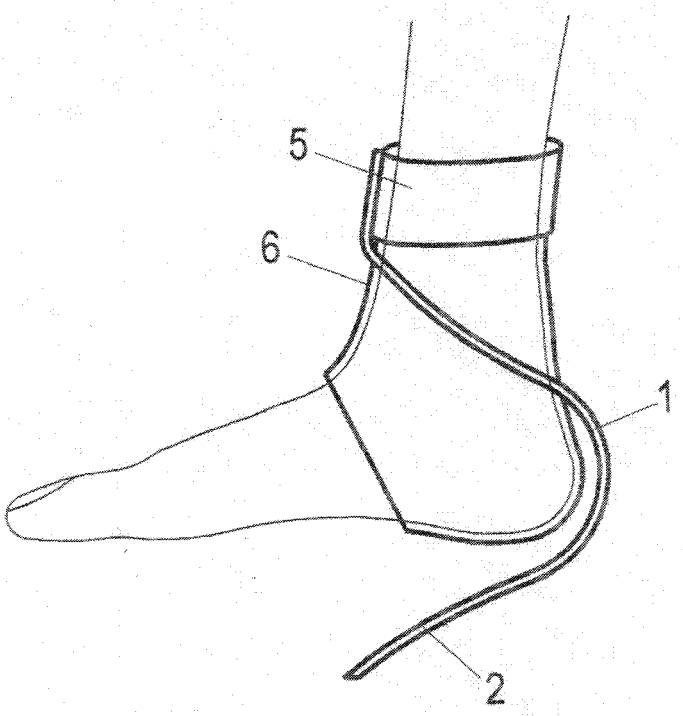



Fig. 4b

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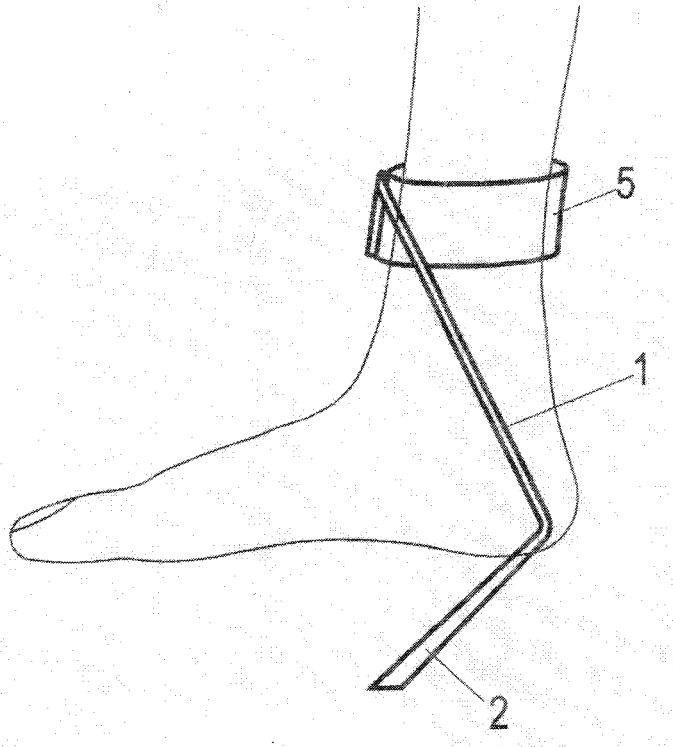



Fig. 6a

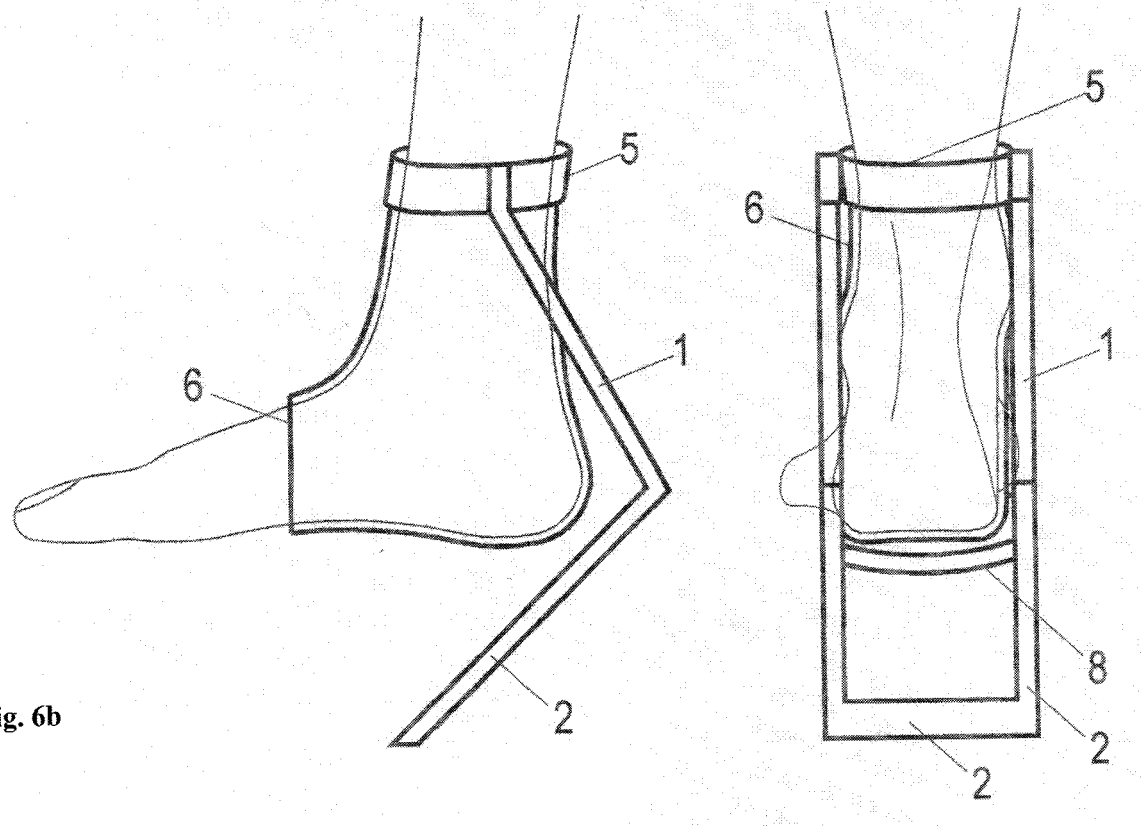



Fig. 6b

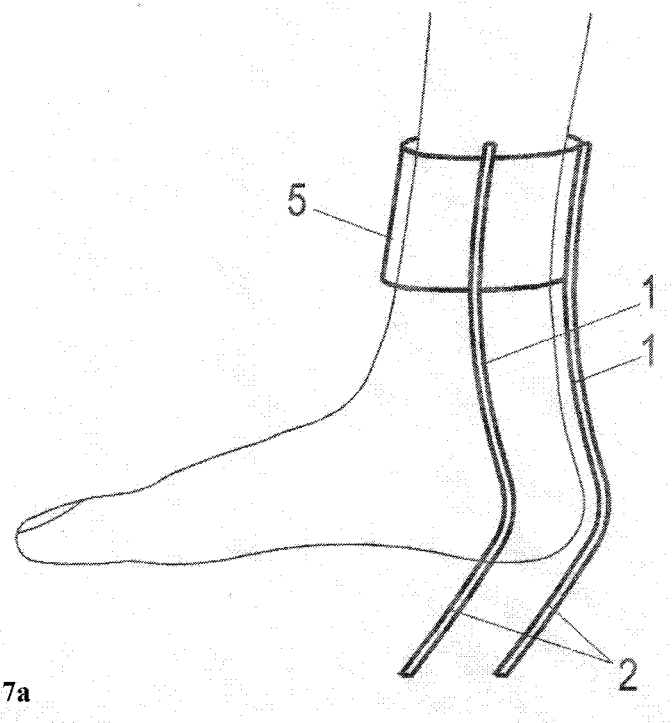



Fig. 7a

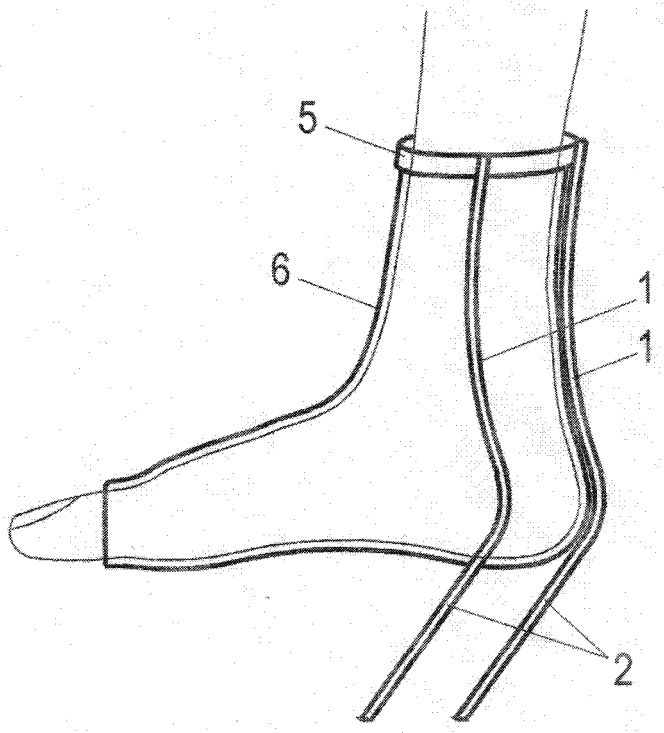



Fig. 7b

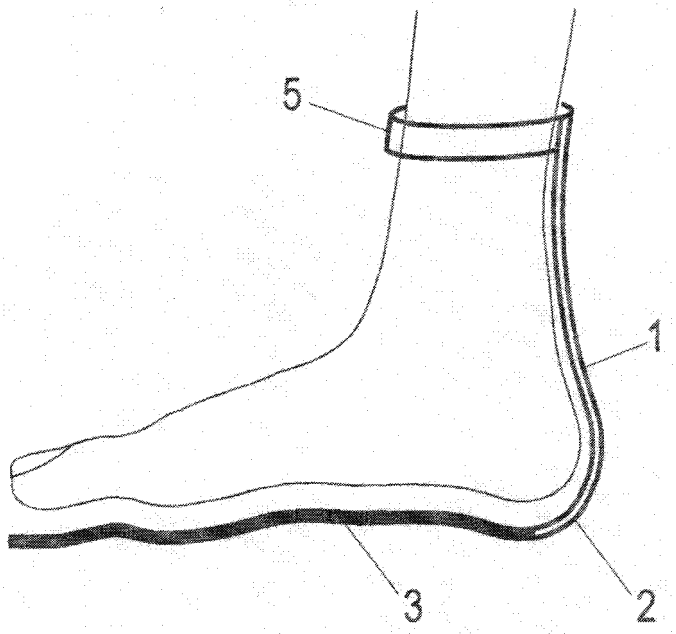



Fig. 8a

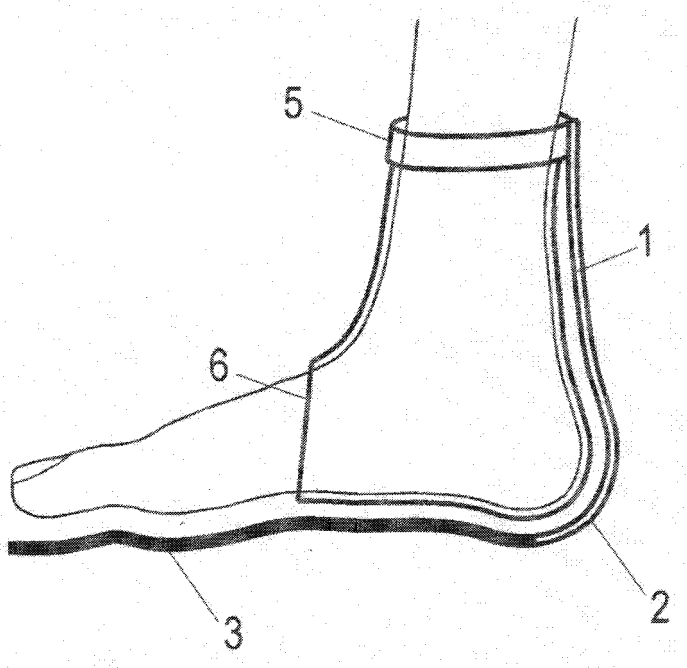



Fig. 8b

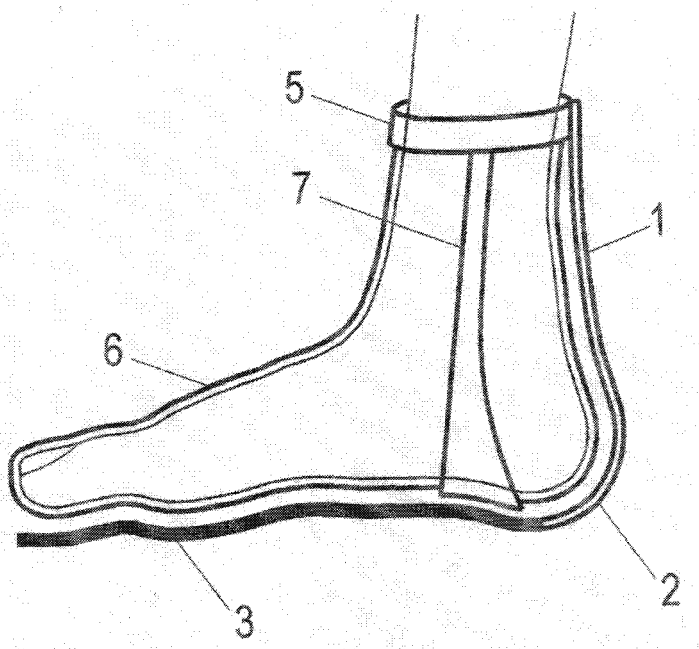



Fig. 8c

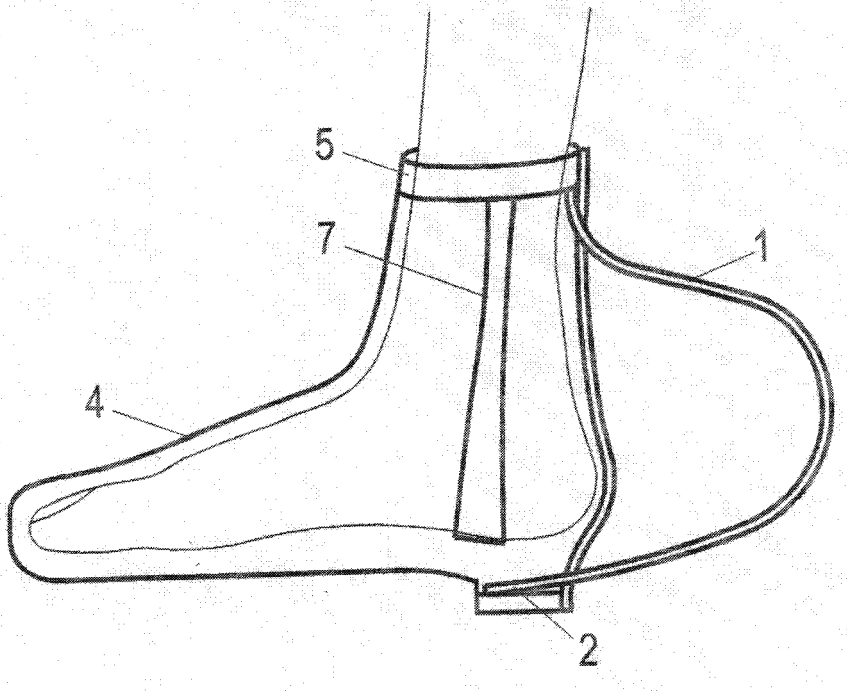



Fig. 9

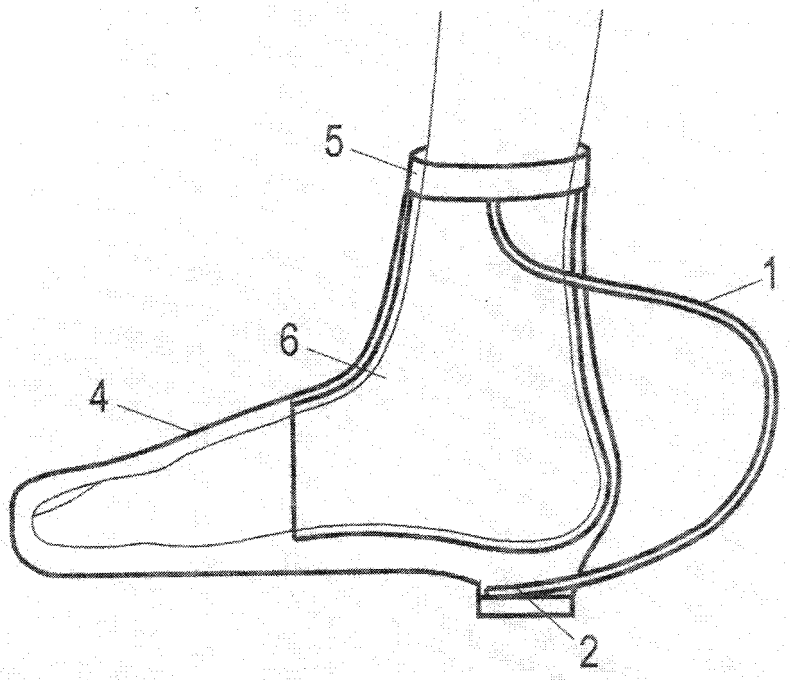



Fig. 10

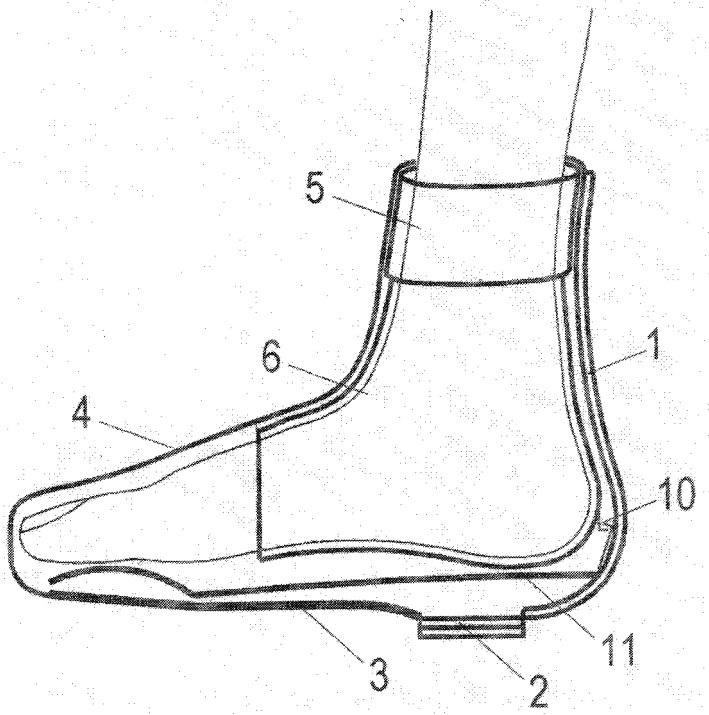



Fig. 11a

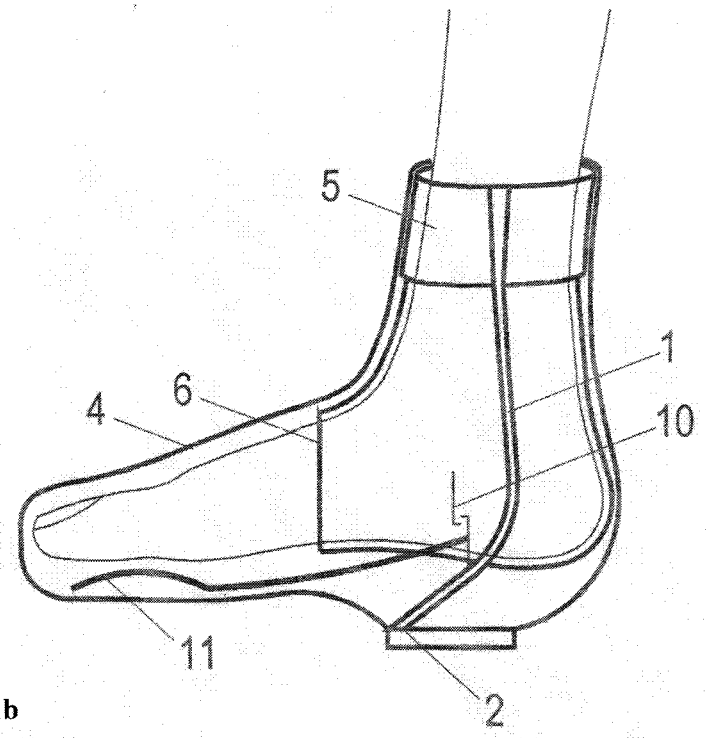



Fig. 11b

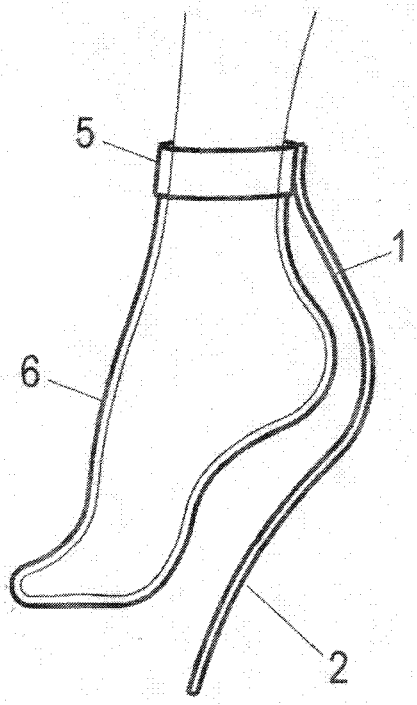



Fig. 12a

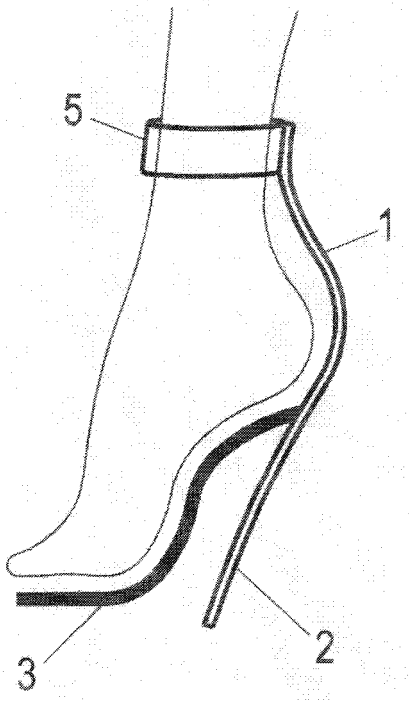



Fig. 12b

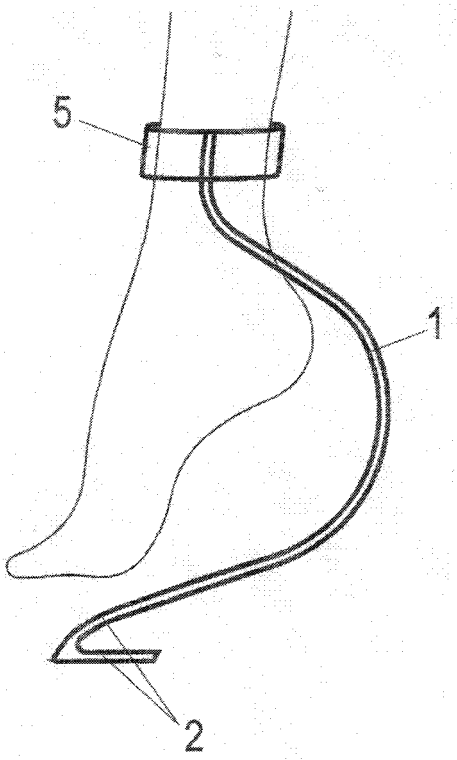



Fig. 12c

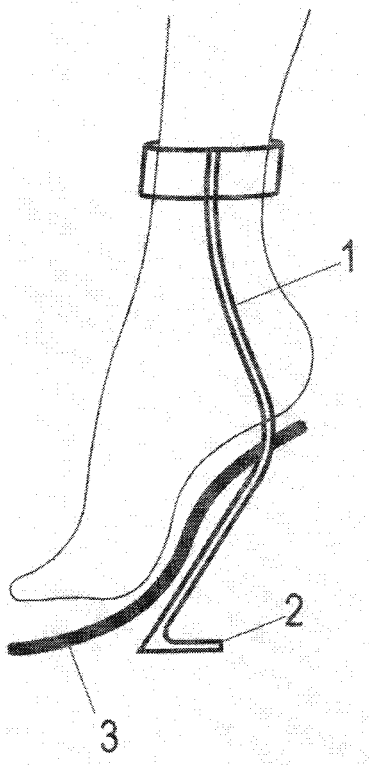



Fig. 12d

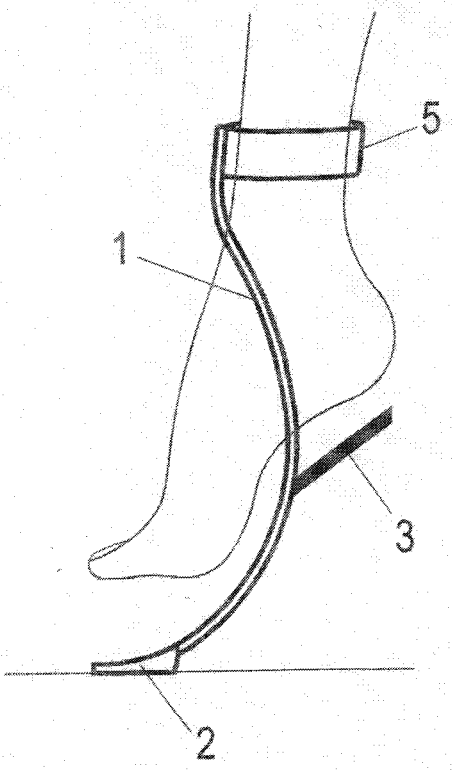



Fig. 12e

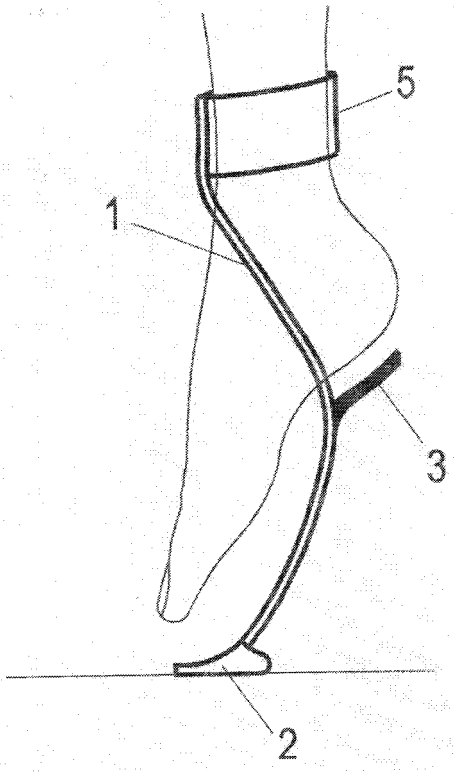
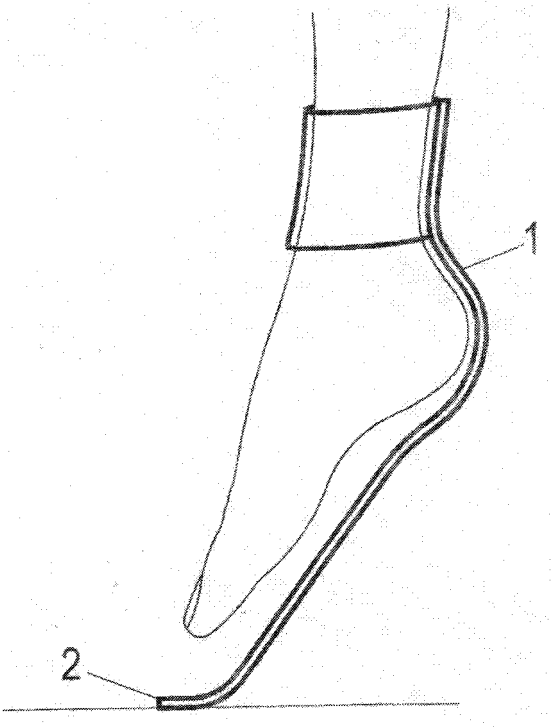



Fig. 12f

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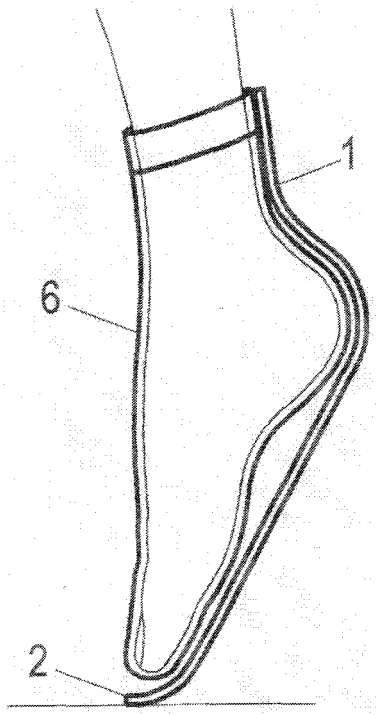



Fig. 13b

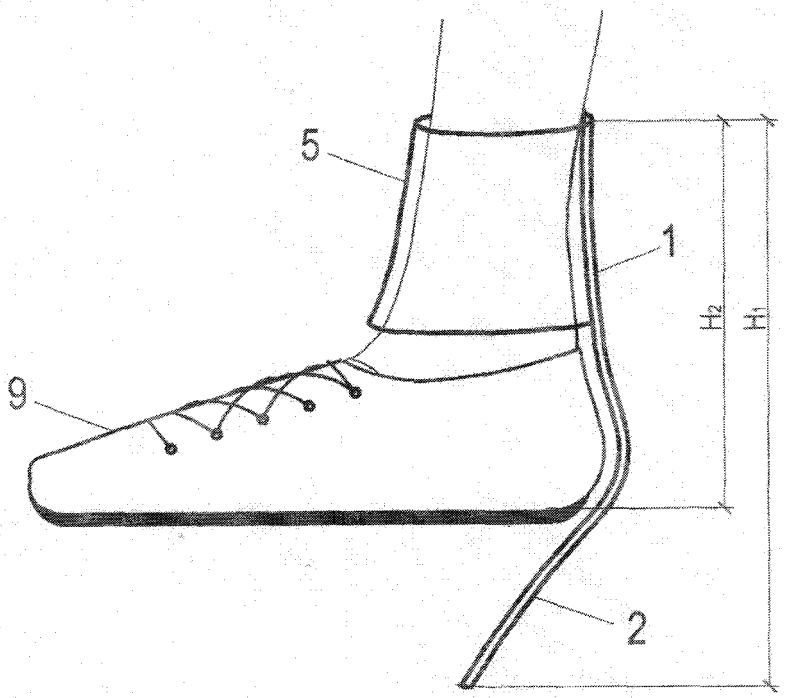



Fig. 14

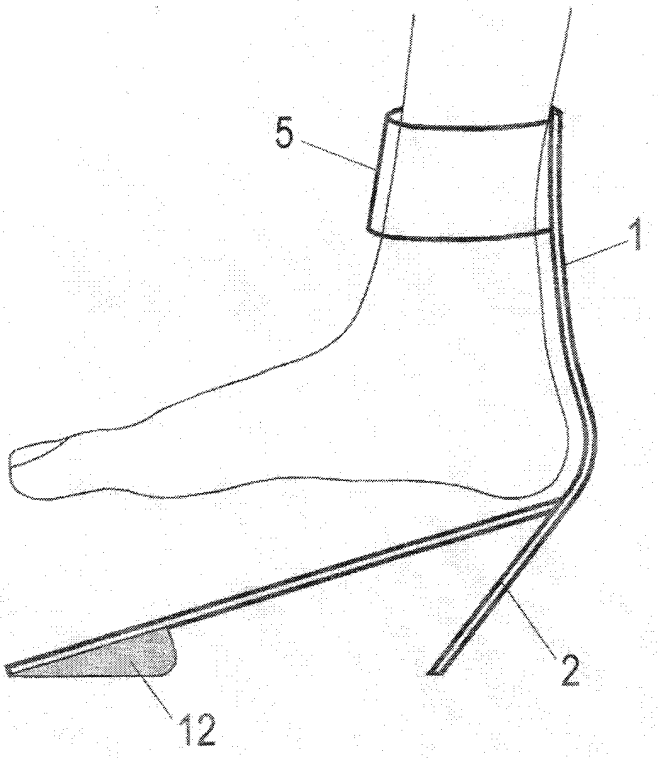



Fig. 15

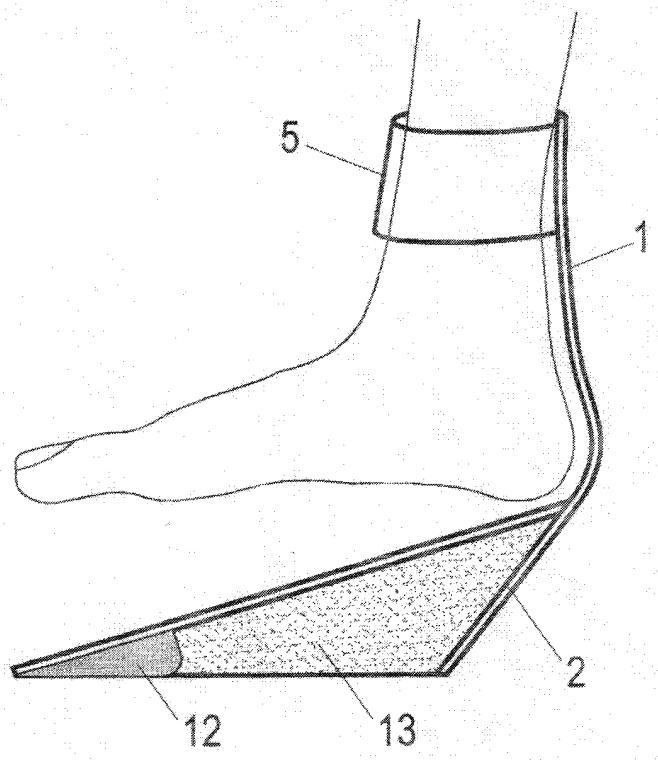



Fig. 16

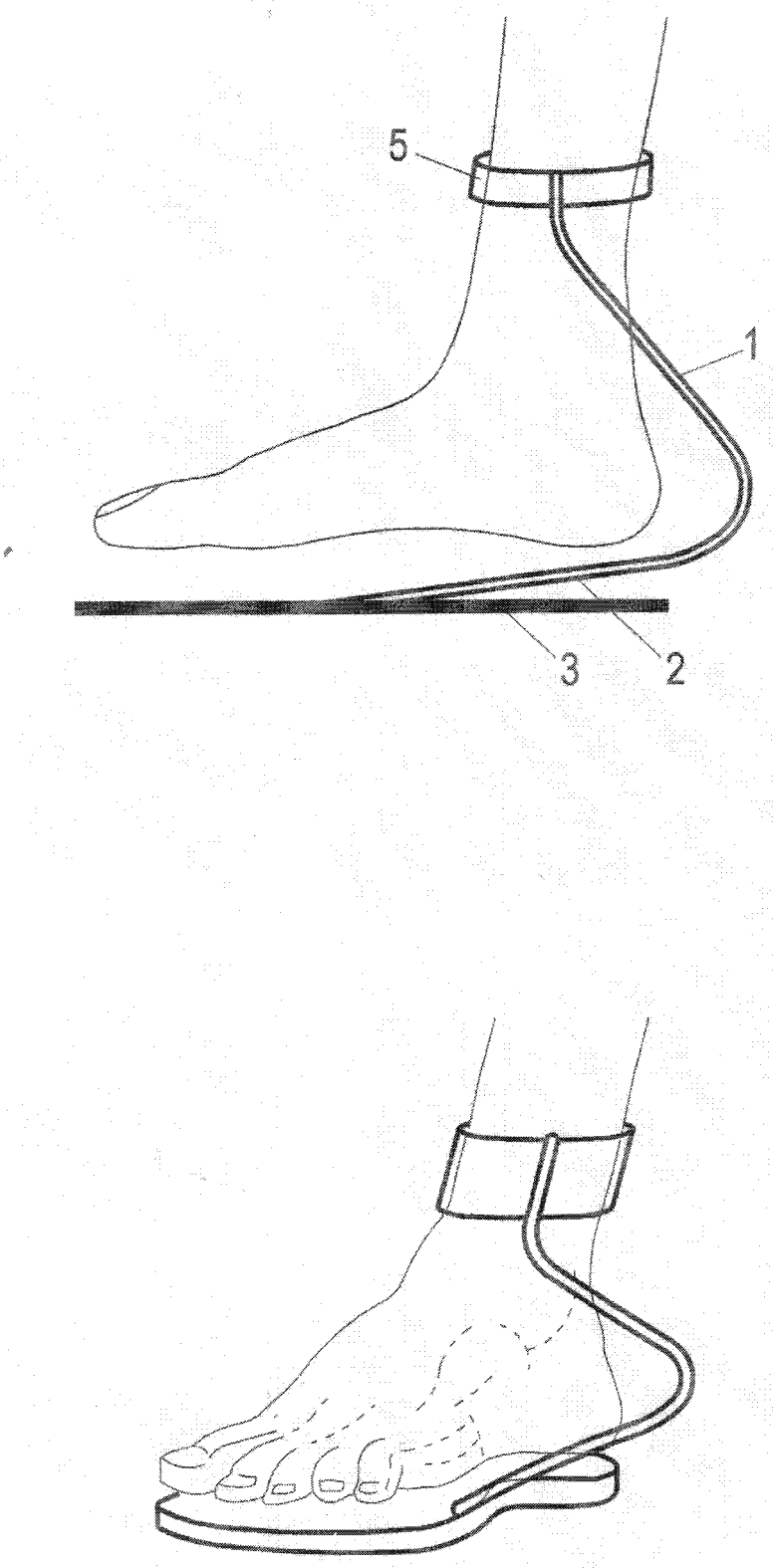



Fig. 17

Fig. 18a

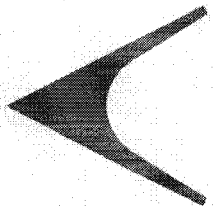


Fig. 18b

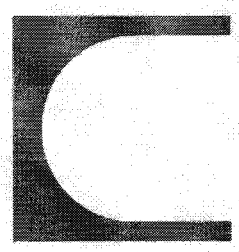
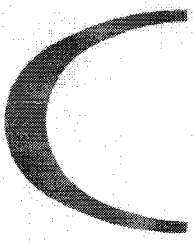


Fig. 18c

Fig. 18d



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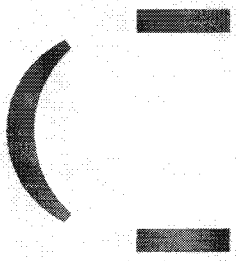
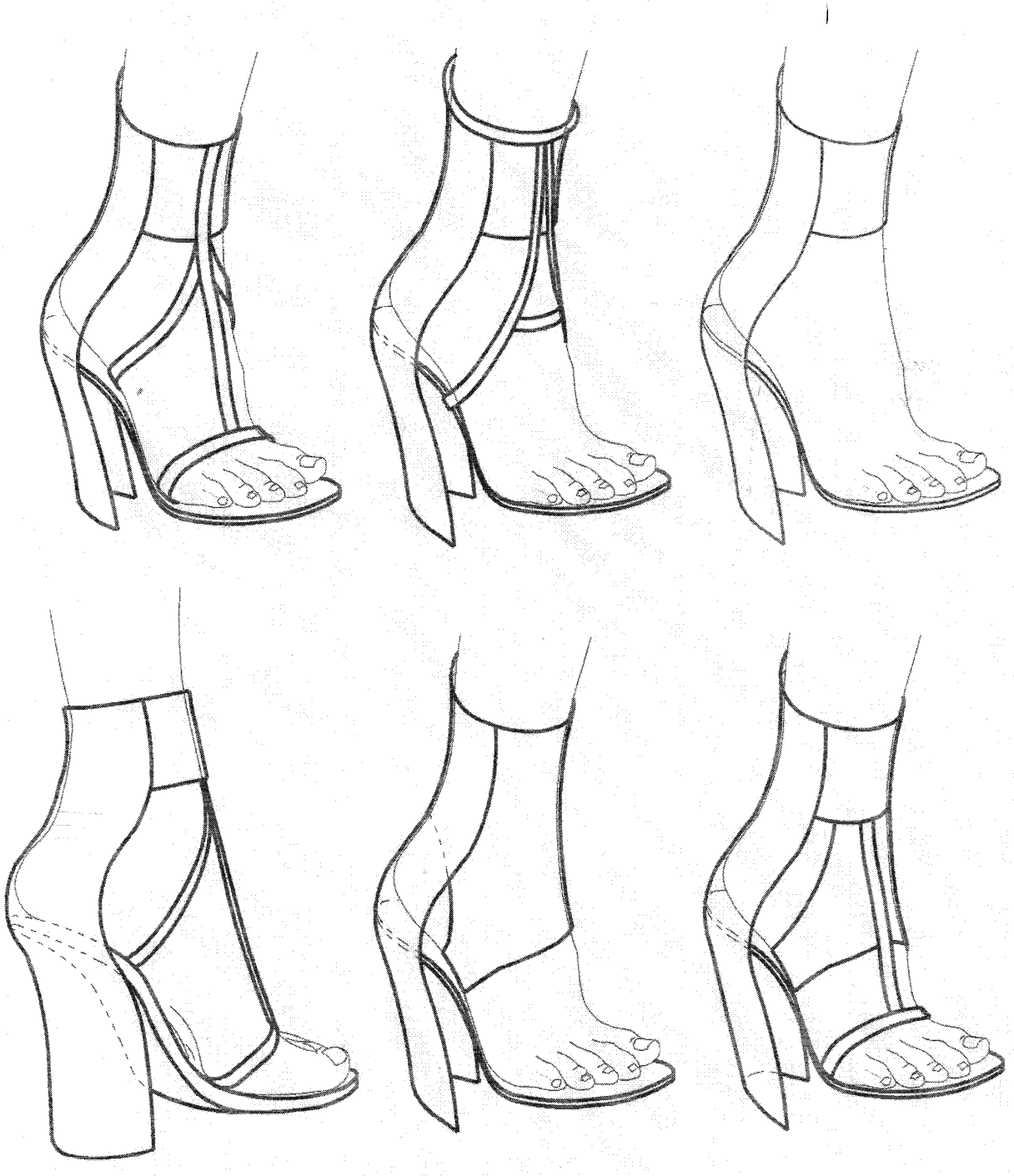


Fig. 18f



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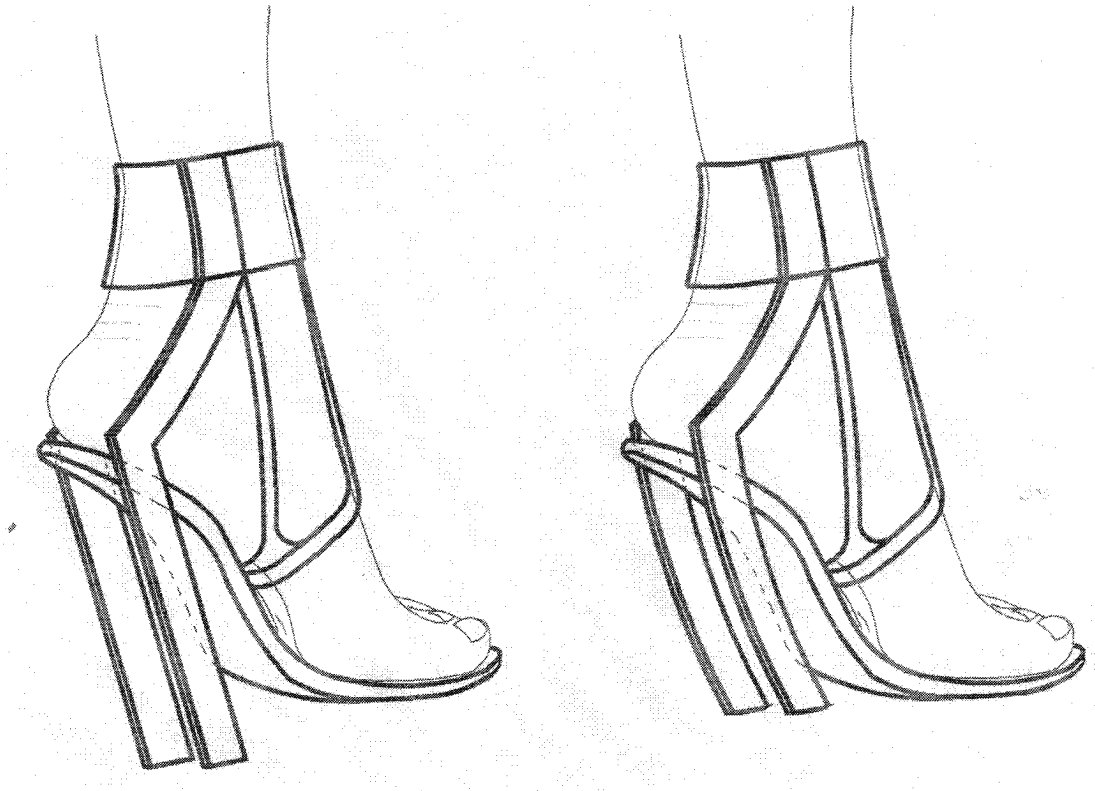

Phase 1 Phase2

Fig. 20

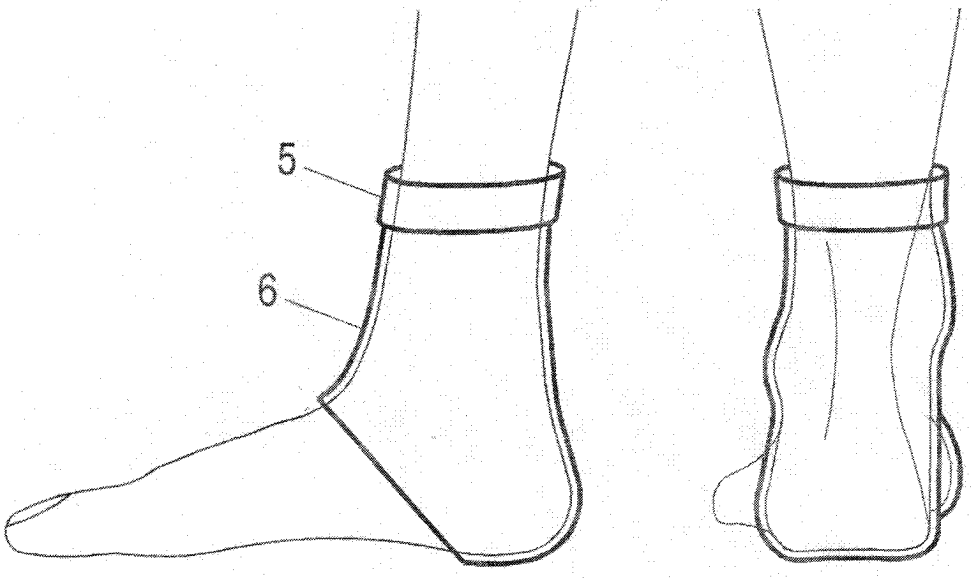


Fig. 21

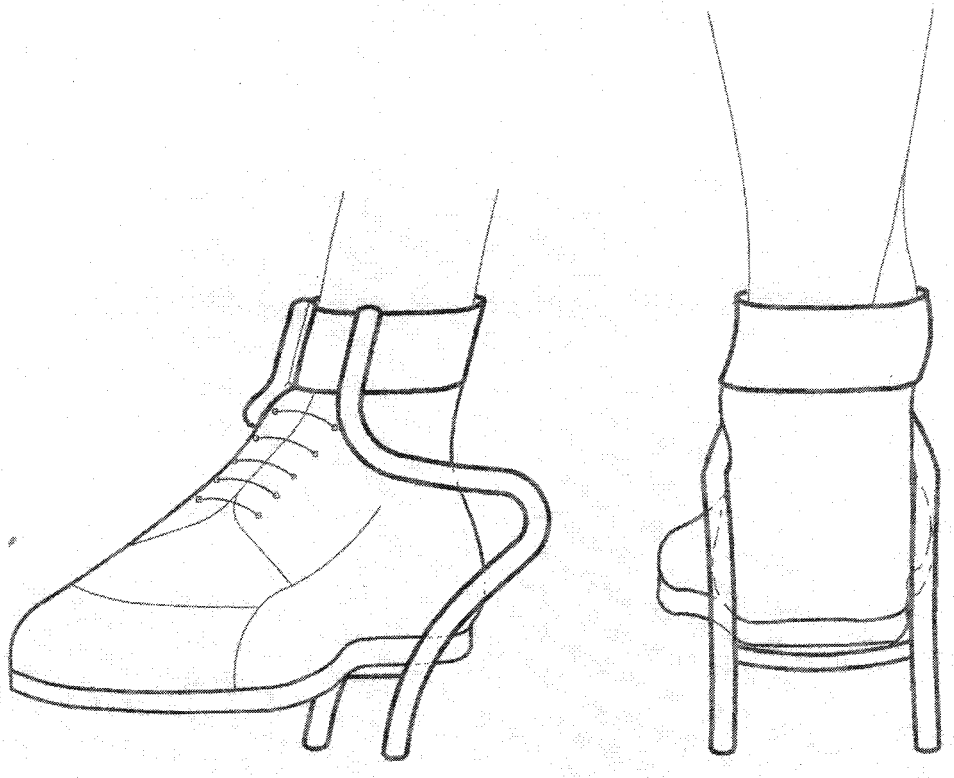

Fig. 22

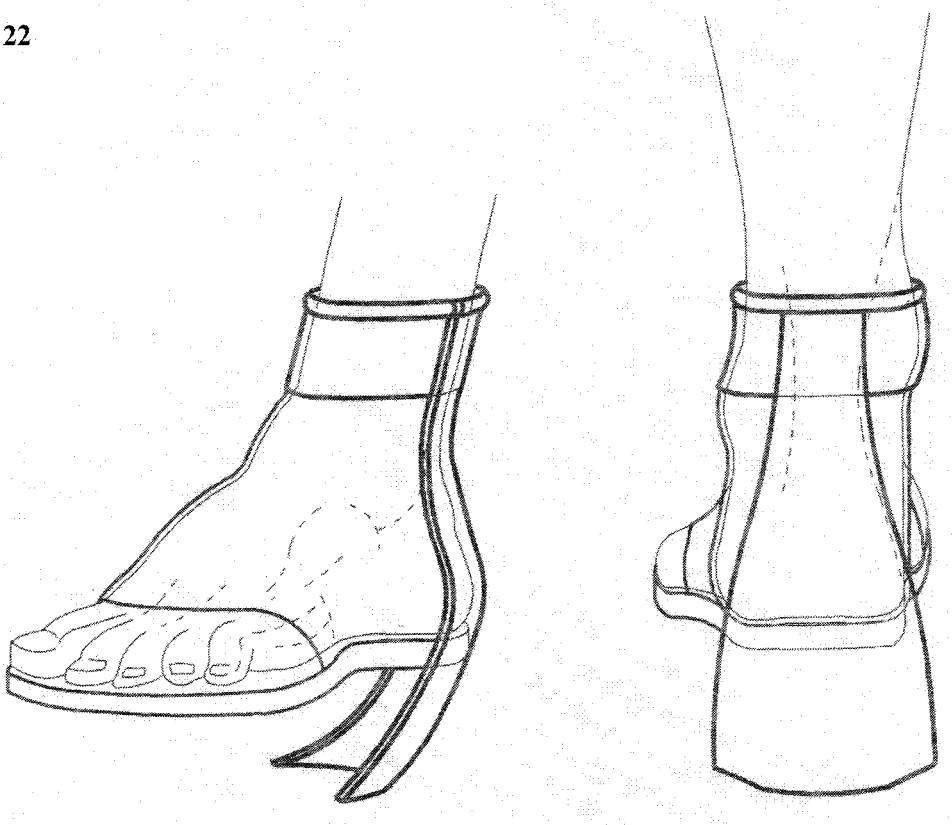

Fig. 23

**INTERNATIONAL SEARCH REPORT**

International application No.
PCT/RU 2010/000043

A. CLASSIFICATION OF SUBJECT MATTER

***A43B 13/14*** *(2006.01)*
***A63B 25/10*** *(2006.01)*

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A43B 13/14, A63B 25/10

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Esp@cenet, DWPI, Shoe, Accumulation of energe, Leaf spring

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | RU 2008107517 A (SHIROKIKH MARK RUDOLFOVICH) 10.09.2009, the abstract, figures 1-6 | 1-14 |
| Y | SU 1169599 A (LYATNITSKY I.I. et al.) 30.07.1985, the abstract, figures 1-2 | 1-14 |
| Y | RU 2160571 C1 (MOSKOVSKAYA GOSUDARSTVENNAYA AKADEMIYA LEGKOY PROMYSHLENNOSTI) 20.12.2000, the abstract, figure 2 | 1-14 |
| Y | US 61 15942 A (FREDERIC PARADIS) 12.09.2000, the abstract, figures 1-16 | 3, 7, 8, 9 |
| Y | EP 1800554 A1 (HEIERLING I-FLEX GMBH) 27.06.2007, the abstract, figure | 12 |

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"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 12 October 2010 (12.10.2010) | 28 October 2010 (28.10.2010) |
| Name and mailing address of the ISA/<br><br>Facsimile No. | Authorized officer<br><br>Telephone No. |

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### Patent documents cited in the description


- US 6719671 B **[0002] [0008]**
- US 6840893 B **[0006] [0016]**
- RU 2008107517 **[0010]**