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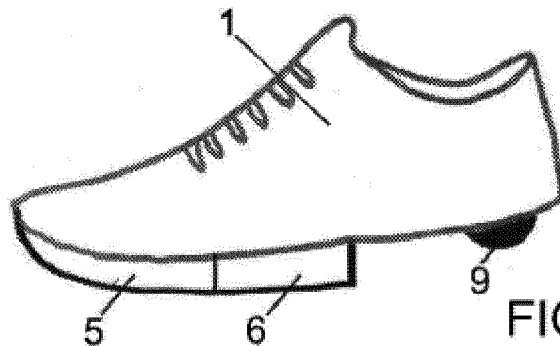
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(54) **SHOE WITH A SUSPENDED HEEL AND METHOD FOR FACILITATING ADAPTATION TO THE NATURAL SUSPENDED HEEL RUNNING TECHNIQUE**

(57) The invention relates to a shoe with a suspended heel, characterized in that the sole lacks the hindfoot part (7), comprising only the sole and the midsole in the forefoot region (5) and the midfoot region (6). The shoe can also lack the midsole in the midfoot region (6) and only have the sole of the forefoot (5) so that the foot is only supported on that part (5), the midfoot and the hindfoot being raised. Any person using the shoe with a suspended

heel and using the method of the invention consisting of the stages of familiarization, integration, progression, adaptation and consolidation allows adaptation to the natural suspended heel running technique by means of support only in the front and/or middle part, and can also use the elastic energy stored in the non-contractile parts of the extensor musculature of the ankle.



**FIG. 12**

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## Description

### TECHNICAL FIELD

**[0001]** The present invention relates to a shoe the structural features of which are such that they allow enhancing the natural suspended heel running technique, i.e., technique in which the first contact of the foot on the ground is with the forefoot and/or with the midfoot, the heel being suspended in the air at that time without touching the ground, thereby assuring the storage of the highest possible amount of elastic energy of the leg and increasing motor performance.

**[0002]** The object of the invention is to enable a person or athlete to make the best use of the energy stored in the ankle, specifically the energy provided by the non-contractile parts of the musculature of the ankle, which offer energy for pushing off without any energy expenditure, while at the same time the typical slowing down and the damaging impact that occur when support first occurs on the rear part of the foot (heel) when running.

**[0003]** The invention also relates to the method for facilitating adaptation to the natural running technique, generating the efficient stride for the runner, specifically by means of the stages of familiarization, integration, progression, adaptation and consolidation, which necessarily require the use of the shoe of the invention, for the purpose of eliminating or reducing the negative phase of the stride and using the elastic energy accumulated in the non-contractile parts of the extensor musculature of the ankle.

### PRIOR ART

**[0004]** There is a huge market for running shoes, and these shoes largely depend on the type of step one has (neutral, pronation or supination), on the terrain and on the type of running, although they all cover the entire foot.

**[0005]** When athletes run, they tend to do it the same way they walk, i.e., first supporting the heel to then slide all of their bodyweight towards the tip of the foot, from where they push off, moving forward, thereby running.

**[0006]** Shoes today are designed to perfectly fit the foot so that they are as comfortable as possible for the athlete; furthermore, they are often provided with cushioning means to try to improve comfort and protect against injuries. However, epidemiological studies indicate that this objective is not achieved.

**[0007]** Going back to how the foot is supported on the ground while an athlete runs, when the heel is supported first, as is conventional, the rear, middle and front parts of the foot are supported in front of the center of gravity, thereby bringing about the negative phase in each stride, slowing down the progress of the runner.

**[0008]** Furthermore, the contact time of the foot on the ground is greater than when the entire sole of the foot, including the heel, is supported, and therefore it will take longer to push off again and thus start into a new stride,

which impairs performance.

**[0009]** At the same time, since the elastic component of the non-contractile parts of the musculature of the ankle is not activated, the possible elastic energy is not used, so the energy contributing to the progress of the runner is less.

**[0010]** In addition, it should be pointed out that for many centuries some athletes have run barefoot, which is the natural way to run for which the foot is prepared and which logically consists of supporting the middle and front parts of the foot, without supporting any other part.

**[0011]** They do this for several reasons, firstly, to use the natural cushioning mechanisms; secondly, to prevent impact on the heel which is transmitted to the rest of the body and which is related to different injuries.

**[0012]** Thirdly, they do this to use the elastic energy stored in the ankle right before pushing off, generating a more advantageous stride.

**[0013]** Other trends in the field of running are known today which should be mentioned and included in the same group because they have a similar objective. These two trends are: barefoot running and minimalist running. They both try to return to the natural running technique, the former being barefoot and the latter being with new shoes that resemble shoes from the beginning of the 19<sup>th</sup> century, which are characterized by have little cushioning and offer scarce support for the foot. These trends have two major drawbacks: on one hand, using footwear of this type or going barefoot does not assure running with a natural running technique; and on the other hand, given how little people today are used to walking and running without protection, associated injuries, such as stress fractures or lacerations on the sole of the foot, arise.

**[0014]** As a result, it can be asserted that no shoe or method for the adaptation of runners to the natural running technique is known which allows using all the anatomical-muscle elements of humans, avoiding muscle, bone, tendon, ligament and even joint injuries.

### DISCLOSURE OF THE INVENTION

### DISCLOSURE OF THE INVENTION

**[0015]** The shoe proposed herein is characterized in that the sole and midsole thereof take up only the front part, the heel having been eliminated. In other words, in this shoe, the sole and midsole take up only the front and middle parts of the shoe, the midsole having a cushioning function.

**[0016]** This new concept is envisaged for being applied in shoes created so that runners today can learn to run better and faster, imitating how African athletes run, who do so by applying the most natural technique that exists, i.e., running barefoot, but furthermore with the use of the shoe of the present invention, more elastic energy can be stored than when running barefoot since the ankle is suspended in the air at all times, particularly when the sole of the foot is completely parallel to the ground or

when the ankle joint is bent less than 90°.

**[0017]** According to the new concept of the sole and midsole of the shoe, the heel is raised or suspended in the air, such that the shoe provides a good fit with respect to the foot, and furthermore suitable cushioning, making it easier for the runner to support the foot only on the front and middle regions of the foot in each stride. Since the runner's heel cannot be supported as said part has been eliminated from the sole and/or midsole, the slowing down as well as excessive load caused by said support are reduced, and the storage and release of the elastic energy stored in the non-contractile parts of the extensor musculature of the ankle in the form of a pushing off force is favored, thereby improving the motor performance caused by the front support of the foot and allowing a change in the running technique.

**[0018]** In short, by means of the shoe of the invention, the entire support of the foot while running is concentrated in the front part thereof, and better efficiency in the receiving, cushioning and push off of each stride is achieved.

**[0019]** In an embodiment variant, the shoe can receive complements in the rear part of the sole and/or midsole, with interchangeable sections, i.e., in the second embodiment of the shoes, supplements or complements of the sole and midsole have been envisaged for their insertion in the rear part, specifically in the hindfoot region, for the purpose of being able to partially or completely cover this rear part.

**[0020]** At the same time, it must be taken into account that the midsole and/or sole located in the forefoot and/or midfoot can also be made up of just one or several sections or modules, which can also be attached to or separated from one another, these modules furthermore being fixed and/or movable for the purpose of being able to be removed and attached by means of any type of anchoring or securing. These modules can also be moved from one part to another, or even turned.

**[0021]** Furthermore, any segment located in the midfoot and/or hindfoot of the shoe can be different from one another as regards size, width, length, height, thickness, depth, shape, form and density.

**[0022]** Since these segments or complements can be attached to and removed from the hindfoot, both the adaptation to the natural running technique and the progressive assimilation thereof are facilitated.

**[0023]** Accordingly and as needed, as a result of these segments or complements the athlete can support the foot on the ground in three different ways:

- With the entire sole of the foot (hindfoot, midfoot and forefoot) when the shoe has all the segments or complements.
- With the middle and front parts of the foot (midfoot and forefoot) when the shoe does not have the segments or complements located in the hindfoot.

- With only the front part (forefoot) when the shoe does not have the segments or complements located in the hindfoot or in the midfoot.

**[0024]** When a shoe in which the support is only in the front part or in the middle and front parts is used, then the muscular force will be intensified and the running technique and stride frequency will also be improved, because when one or several segments or complements of the sole and/or midsole are eliminated from the midfoot region, in this second embodiment variant, the heel is suspended in the air, generating a certain 'floating' that favors using the elastic energy accumulated in the non-contractile parts of the extensor musculature of the ankle to generate greater push off in the stride.

**[0025]** In addition, stride frequency/speed will improve the less sole surface there is in the shoe, i.e., the more sections that have been removed, because with it there will be a smaller contact surface touching the ground and therefore greater speed as regards the take off of the foot from the ground itself. Furthermore, the elastic component that is activated in the soleus and calf muscles due to overstretching allows the storage of elastic energy in the non-contractile parts of the extensor musculature of the ankle, and helps the push off to be greater and more effective.

**[0026]** The following can be mentioned among the advantages and improvements brought about by the shoe of the invention because it comprises the sole only in the middle and front parts, compared to conventional and/or minimalist shoes:

- It protects the middle and front parts of the foot during the support.
- It facilitates the use of natural cushioning systems, i.e., those provided by the ankle, knee and hip joints.
- It facilitates activation of the elastic mechanisms of the tendons and of the connective tissue, thereby using the elastic energy generated in the leg and foot, to increase motor performance and efficiency.
- It allows the ankle to remain in the most advantageous position during the support to generate force, said position being in the central region of its range of movement, i.e., the ankle is at 90° and suspended.
- It facilitates reproducing the propelling mechanisms of bipedal mammals with greater energy efficiency in movements.
- The complements of the shoe facilitate its use in different contour conditions and for different levels of runners and physical shapes, i.e., for walking and running as if it were a conventional sport shoe; or the runner can modify the structure of the midsole as desired and benefit from the advantages it offers.

- The complements increase the functionality of the shoe of the invention and guide the runner in the method allowing the adaptation to the natural running technique, allowing the elimination or significant reduction of the negative phase of the stride. 5
- The shoe allows strengthening the extensor musculature of the ankle, reduces the negative phase or slowing down phase of running. 10
- It can increase the running pace with respect to conventional shoes.
- It can increase the stride width with respect to minimalist shoes. 15
- It can reduce pronosupination with respect to conventional shoes.

**[0027]** With respect to the method for achieving the adaptation to the natural running technique and being able to better use the elastic energy from the activation of the elastic components of the non-contractile parts of the extensor musculature of the ankle of the runner using these shoes object of the invention, the following stages are proposed: 20

- Stage of familiarization: the person performs basic jumping, falling, climbing, pushing off, receiving, and walking training exercises, as well as sprints and short-distance running using the shoe with a suspended heel without segments or complements in the hindfoot region and without a segment or with no segment in the midsole and/or sole of the midfoot region; there being no contact of the heel on the ground at least 90% of the time, and the measurement being taken with high-speed chambers or a force platform. The approximate duration is from 2 to 4 weeks, although the person can stay in this stage of familiarization for a longer time if preferred or even return to this stage once it has been surpassed if deemed appropriate. 30
- Stage of integration: the person performs basic jumping, falling, climbing, pushing off, receiving, and walking training exercises, as well as sprints and short-distance running using the shoe with a suspended heel without segments or complements in the hindfoot region and without a segment or with no segment in the midsole and/or sole of the midfoot region, also running continuously from 500 m up to 2 km, whereas when running continuously for up to 5 km shoes with a suspended heel are used with the adaptation complements being inserted. The beginning of the plantar support during supination and contact with the region of the fifth metatarsal is measured by means of instrumented insoles, reaching a slight forward inclination of the torso of between 50 45

and 100, the measurement being taken with high-speed chambers, and when running continuously for up to 2 km there is no contact of the heel on the ground at least 90% of the time (the measurement being taken with high-speed chambers or a force platform). The approximate duration is from 6 to 8 weeks, although the person can stay in this stage for a longer time if preferred or even return to this stage once it has been surpassed if deemed appropriate. 10

- Stage of progression: the person runs continuously from 2 km to 5 km using the shoes with a suspended heel without complements in the hindfoot region and without a segment or with no segment in the midsole and/or sole in the midfoot region, runs continuously for up to 8 km with the shoes with a suspended heel with adaptation complements, being able to start competing in trials of less than 2 km with the shoes with a suspended heel with adaptation complements; a negative phase below 5% of the total support is measured with high-speed chambers, the peak of the impact being reduced and measuring a position of plantar flexion of the foot at least 90% of the time, and there is no contact of the heel on the ground when running continuously for up to 5 km at least 90% of the time (the measurement being taken with high-speed chambers or a force platform). The approximate duration is from 6 to 8 weeks, although the person can stay in this stage for a longer time if preferred or even return to this stage once it has been surpassed if deemed appropriate. 20

- Stage of adaptation: the person runs continuously for up to 12 km using the shoes with a suspended heel with adaptation complements, performs interval training exercises of 200 m to 1.5 km with the shoes with a suspended heel without complements in the hindfoot region and without a segment or with no segment in the midsole and/or sole in the midfoot region, runs competitively for less than 5 km with the shoes with a suspended heel with adaptation complements; it is measured with high-speed chambers during the support phase that the foot remains at about 90° and does not touch the ground, whereas after a vertical jump using the shoes with a suspended heel, the heel continues to store elastic energy when the forefoot and/or the midfoot are supported in the anatomical position with respect to the ground at least 90% of the time, there being no contact of the heel on the ground at least 90% of the time during anaerobic running for distances up to 400 m. In this stage, it is verified by means of high-speed chambers that the path of the foot before coming into contact with the ground is complete, i.e., right before contact on the ground, the foot describes a front-to-back path, forming a vector in the same direction as the running direction and opposite thereto. The approx- 45

imate duration is from 6 to 8 weeks, although the person can stay in this stage for a longer time if preferred or even return to this stage once it has been surpassed if deemed appropriate.

- Stage of consolidation: the person runs continuously for up to 30 min. with the shoes with a suspended heel without complements in the hindfoot region, performs interval training exercises of 200 m to 2 km with the shoes with a suspended heel without adaptation segments or complements in the hindfoot region and without a segment or with no segment in the midsole and/or sole in the midfoot region, runs continuously for up to 15 km using the shoes with a suspended heel with complements, runs competitively for up to 3 km with the shoes with a suspended heel without complements in the hindfoot region and without a segment or with no segment in the midsole and/or sole in the midfoot region and runs competitively for less up to 10 km with the shoes with a suspended heel with adaptation complements. The contact time below 150 ms is measured with high-speed chambers, instrumented insoles, accelerometers or a force platform, there being no contact of the heel on the ground at least 90% of the time during anaerobic running for distances up to 1 km. The approximate duration is from 6 to 8 weeks, although the person can stay in this stage for a longer time if preferred.

**[0028]** As a warning, in each stage any runner observing any body discomfort in the feet or the legs is advised to cease the activity for one week, to later start from the beginning in the stage the runner was in.

**[0029]** As a recommendation, the heel should not touch the ground when using the shoe of the invention without complements. The heel should always be in the air or suspended, even during those times used for walking. Nevertheless, if the athlete is tired the shoe of the invention can be used with the complements of the hindfoot inserted or the runner can sit down to rest.

**[0030]** Furthermore, when following the method of the invention the shoes should not be used without complements for two consecutive days, avoiding the interval series in paths with curves in those stages that contemplate them.

**[0031]** The person can, as desired, prolong the duration of each stage, stay in it forever or go back to preceding stages, but it is ideal for the runner to follow the scheduled pace to achieve the objectives set and the best benefits

**[0032]** In addition, it is also recommended that in the hypothetical case that the person does not have the adaptation complement, it could be momentarily replaced using any other type of shoe, although it would be ideal that in this replacement shoe the difference in the thickness of the midsole and/or sole between the heel part and the part located at the fifth metatarsal is minimal,

being 0 mm.

**[0033]** A relevant aspect is that in each of the stages of the method certain parameters are measured for the purpose of being able to confirm that the objectives set have been achieved, and it is possible to move on to the following stage.

**[0034]** The instruments used for measuring the set parameters are:

- High-speed chambers for measuring the impact region (forefoot, midfoot or hindfoot) during the training exercise, inclination of the torso, vertical movement of the heel during the support, measurement of the negative phase with respect to the total support phase, position of the foot during the support and path of the foot.
- Force platform: for measuring the contact time of the foot, peak of the impact, stride width and for indirectly estimating the elastic energy stored in the heel after a jump.
- Instrumented insoles: measuring the support frequency and analyzing the plantar support.

**[0035]** Runners that surpass the stage of consolidation using the shoes described in the invention will have achieved using the elastic energy stored in the non-contractile parts of the extensor musculature of the ankle, reducing the negative phase of their stride while running and achieving a natural suspended heel running technique that may allow them to sustain fewer injuries due to this exercise.

**[0036]** Finally, it must be stress that the described method is easy to follow for a runner that can run continuously for at least fifteen minutes and is accessible for all runners, regardless of their age, sex and athletic level.

**[0037]** However, people with foot or leg injuries or who are overweight or suffer from heart diseases are advised to talk to a specialist physician, an orthopedic surgeon, a physical therapist or a foot doctor to receive their customized recommendations before using the shoe of the invention and following the described method.

**[0038]** Once athletes have finished these five phases, they must keep up the correct running technique using the shoes of the invention, but without falling into excessive use.

**[0039]** Finally, it must be indicated that in the event that the person using the method of the invention is a child up to 15 years old, only the three first stages of the method should be carried out furthermore taking into account that:

- Children 10 years of age will run for a maximum of 25 consecutive minutes in a single session
- Children 11 years of age will run for a maximum of 30 consecutive minutes in a single session

- Children 12 years of age will run for a maximum of 30 consecutive minutes in a single session
- Children 13 years of age and adults who are just starting to run will run for a maximum of 40 consecutive minutes in a single session
- Children 14 years of age will run for a maximum of 45 consecutive minutes in a single session

#### DESCRIPTION OF THE DRAWINGS

**[0040]** To complement the description that will be made below and for the purpose of helping to better understand the features of the invention according to a preferred practical embodiment thereof, a set of drawings is attached as an integral part of said description in which the following is depicted with an illustrative and non-limiting character:

Figure 1 shows a perspective view of a shoe with front support made according to the object of the invention.

Figure 2 shows a side view of the same shoe depicted in the preceding figure.

Figure 3 shows a side view of the shoe from the preceding figure showing the detail of the athlete's foot inside the shoe.

Figure 4 shows the configuration of the same shoe depicted in the preceding figures provided with a complement referred to as adaptation complement.

Figure 5 shows the configuration of a sole and midsole of the shoe of the invention, taking up the forefoot region and the entire midfoot region.

Figure 6 shows another configuration of the sole and midsole, taking up the forefoot region and half of the midfoot region.

Figure 7 shows a configuration of the sole and midsole taking up only the forefoot part.

Figure 8 shows a side view of a shoe which, in addition to the sole and midsole parts of the forefoot, includes an intermediate segment or complement in the midfoot region and another complement in the rear or in the hindfoot region.

Figure 9 shows a view like the one in the preceding figure, in which the intermediate complement or segment of the midfoot is divided into two parts, a front part and a rear part.

Figure 10 shows a view of the same shoe depicted

in Figures 8 and 9, but with the hindfoot divided into two parts and the midfoot with a front region and a rear region also divided into two parts.

Figure 11 shows the same shoe of Figure 9 lacking the midsole and sole parts of the hindfoot.

Figure 12 shows a view of the shoe of Figure 8, where the complement of the hindfoot has been replaced with a rear support complement.

Figure 13 shows a graph representing the impact recorded at the beginning of the support while running using the shoe of the invention, a conventional shoe and a minimalist shoe.

Figure 14 shows a graph representing the contact time in ms with respect to the type of footwear used, distinguishing between a conventional shoe and a shoe with a suspended heel.

Figure 15 shows a graph representing the number of strides per minute of the runner with respect to the type of footwear used, distinguishing between a minimalist shoe and a shoe with a suspended heel.

#### DETAILED DISCLOSURE OF THE INVENTION

**[0041]** As can be seen in said drawings, and specifically in relation to Figures 1, 2 and 3, a shoe (1) having a tie lace (2), and a sole and/or midsole (3) is shown, Figure 3 showing the silhouette of a foot inside the shoe (1), which foot is indicated with reference number (4).

**[0042]** In any case, the shoe shown in said Figures 1, 2 and 3, is characterized in that the sole and/or midsole (3) take up the forefoot region and part of the intermediate region, whereas it lacks a midsole and sole in the hindfoot part.

**[0043]** Specifically, Figure 4 depicts the shoe of Figure 3 where the sole takes up the forefoot region (5) and part of the intermediate region (6), provided with an adaptation complement (8) in the hindfoot region (7) without taking up this part completely.

**[0044]** Furthermore, in Figure 5 the sole and midsole (3) take up the entire forefoot region (5) and midfoot region (6) completely, there being no sole and midsole in the hindfoot (7), whereas in Figure 6 the sole and midsole (3) take up the forefoot region (5) and the midfoot region partially, and there being no hindfoot (7).

**[0045]** In Figure 7, the sole and midsole (3) only take up the entire forefoot part (5), there being no midsole and sole in the midfoot (6) and in the hindfoot (7).

**[0046]** Therefore, the shoe (1) generally shown in Figures 1 to 7, both included, is a shoe the sole and/or midsole of which is eliminated in the rear part so that the person or athlete can only be supported on the front part or forefoot (5), as in Figure 7, can be supported on the front part or forefoot and/or partially supported the mid-

foot (5), as in Figure 6, or can be supported on the intermediate part or midfoot completely and/or the forefoot (6), as in Figure 5.

**[0047]** Figures 8 to 12, both included, show embodiment variants of the shoe (1) in which the midsole and/or sole located in the midfoot can be formed by a single module (6), or several modules (6'), (6''), (6''') coupled in the shoe in a fixed or movable manner (removable). Furthermore, the shoe can be provided with adaptation complements located in the hindfoot such as the element (8) shown in Figure 11.

**[0048]** In turn, the segment or complement corresponding to the hindfoot (8) can also be formed by two superimposed parts (8'), as depicted in Figure 10, or said hindfoot part (8) can even have a thickness less than parts (6') or (6'') forming the segment of the midfoot (6) of Figure 11.

**[0049]** Finally, as depicted in Figure 12 the hindfoot region will be lacking, as seen in Figures 1 to 7, the corresponding segment and in its place a support complement (9) can be arranged.

**[0050]** In all the cases shown in Figures 7 to 12, sections (6) and (8), whether they are formed by single parts or by dual parts, as stated above, can be attached and removed, as desired, for the most suitable use.

**[0051]** In fact, the adaptation complements (6) and (8) and the support complement (9) are fixed and/or movable modules which can be coupled and uncoupled at any time; they could also be moved over the surface of the sole and/or midsole from one place to another, and even be turned, as desired, for the most suitable use. The sizes, shapes, forms, widths, depths, designs, thicknesses, densities, heights and lengths can be different.

**[0052]** By means of the shoe with a suspended heel described in any of its embodiments, without complements in the hindfoot (7), and the method described in detail below, adaptation of the athlete to the natural running technique is facilitated, the use of the elastic energy stored in the ankle is achieved and the negative phase of the stride is reduced. The mentioned method contemplates the following stages:

- Stage of familiarization, in which the person or athlete performs basic running, walking, climbing, leaping, receiving, jumping, falling and pushing off training exercises, either in a dynamic or static manner, in any direction, as well as sprints and short-distance running at a constant or varied pace, using the shoe (1) with a suspended heel, i.e., using only the forefoot part (5) and/or the midfoot part (6) without complements in the hindfoot (7), there being no support of the heel on the ground at least 90% of the time and the measurement being taken with high-speed chambers or a force platform.
- Stage of integration: the person uses the shoe with a suspended heel without the complements or sections in the hindfoot while performing basic running,

walking, climbing, leaping, receiving, jumping, falling and pushing off training exercises, either in a dynamic or static manner, in any direction, as well as short sprints and running at a constant or varied pace, running continuously from 500 m up to 2 km, whereas when running continuously for up to 5 km the person will use the shoe with adaptation complements (6) in the sole and/or midsole in the hindfoot (8'), which will help the runner adapt to the new running technique method.

**[0053]** The measurement is taken by means of instrumented insoles in correspondence with the beginning of the plantar support during supination, as well as during contact with the region of the fifth metatarsal, there being a slight forward inclination of the torso of between 5° and 10°, the measurement being taken with high-speed chambers. When running continuously for up to 2 km, there will be no contact of the heel (hindfoot) on the ground at least 90% of the time, the measurement being taken with high-speed chambers and force platforms.

- Stage of progression: the athlete runs continuously from 2 km to 5 km, using the shoe with a suspended heel without complements, i.e. without a sole or midsole in the hindfoot, continuing running up to 8 km with shoe in which the adaptation complements (8 or 8') are included, being able to start competing in trials of less than 2 km with the shoes with a suspended heel with the already discussed adaptation complements, a negative phase below 5% of the total support being measured with high-speed chambers, the peak of the impact being reduced, and measuring a position of plantar flexion of the foot at least 90% of the time and the heel (hindfoot) not being supported on the ground when running continuously for up to 5 km at least 90% of the time, the measurement being taken with high-speed chambers or a force platform, the approximate duration being from 6 to 8 weeks.
- Stage of adaptation: the runner runs continuously for up to 12 km using the shoes with a suspended heel with adaptation complements, performs interval training exercises of 200 m to 1.5 km with the shoes with a suspended heel without complements in the hindfoot (8) and runs competitively for less than 5 km with the shoes with a suspended heel with adaptation complements; it is measured with high-speed chambers during the support phase that the foot remains at about 90° (close to the anatomical position) and the heel does not touch the ground, whereas after a vertical jump using the shoes with a suspended heel, the heel continues to store elastic energy when the forefoot and/or the midfoot are supported in the anatomical position with respect to the ground at least 90% of the time, the forefoot part and/or midfoot part being the parts receiving the im-

pact at least 90% of the time during anaerobic running for distances up to 400 m. In this stage, it is verified by means of high-speed chambers that the path of the foot before coming into contact with the ground is complete. The approximate duration is from 6 to 8 weeks.

- Stage of consolidation: the runner runs continuously for up to 30 min. with the shoes with a suspended heel without the complements in the hindfoot (8), performs interval training exercises of 200 m to 2 km with the shoes with a suspended heel without complements in the hindfoot (8), runs continuously for up to 15 km using the shoes with a suspended heel with adaptation complements, runs competitively for up to 3 km with the shoes with a suspended heel without adaptation complements and runs competitively for up to 10 km with the shoes with a suspended heel with adaptation complements, measuring with high-speed chambers, instrumented insoles, accelerometers or a force platform a contact time below 150 ms, a 3% increase in stride length compared to the phase of integration, a 2% increase in support frequency compared to the phase of integration, and there being no support of the heel (hindfoot) on the ground at least 90% of the time during anaerobic running for distances up to 1 km. The approximate duration is from 6 to 8 weeks.

**[0054]** Finally, it must be indicated that Figures 13, 14 and 15 show the results of the biomechanical study to know the behavior of the person with the shoe of the invention.

**[0055]** Specifically, Figure 13 shows the depiction of the total plantar support time depicted on the X-axis in a certain percentage versus the measurement of force using as a reference the weight force (body weight) of the athlete on the Y-axis. It can therefore be seen that the shoe of the invention (continuous black line) shows no peak in the vertical ground reaction forces, whereas this peak of the impact does appear when using a conventional shoe (discontinuous line) and a minimalist shoe (gray line).

**[0056]** The use of the shoe of the invention and the method described above allows reducing the contact time of the foot on the ground. Therefore, Figure 14 shows how the use of the shoe of the invention (B) allows reducing the contact time of the heel with the ground, thereby increasing athletic performance compared to using a conventional shoe (A).

**[0057]** Figure 15 shows the reduction of the number of strides per minute when the shoe with a suspended heel (B) is used instead of a minimalist shoe (A) while running. Therefore, how much one can run increases and athletic performance is improved with the use of the shoe of the invention.

## Claims

1. A shoe with a suspended heel, susceptible to having any shape or design and being obtained in different materials, **characterized in that** the corresponding sole (3) lacks the hindfoot part (7), such that a single support region for the foot corresponding to the front or forefoot part (5) and the middle part of the foot or midfoot part (6) is defined.
2. The shoe with a suspended heel according to claim 1, **characterized in that** the support region of the sole and midsole (3) takes up only the forefoot part (5).
3. The shoe with a suspended heel according to claims 1 and 2, **characterized in that** the midfoot part (6) is a segment that can be attached and removed as desired.
4. The shoe with a suspended heel according to claim 3, **characterized in that** the segment or complement corresponding to the midfoot (6) is formed by two parts (6') and (6'') that can be attached and removed as desired.
5. The shoe with a suspended heel according to claims 3 and 4, **characterized in that** the midfoot part (6) has a front part (6') and a rear part (6''), the latter divided into two superimposed parts (6'').
6. The shoe with a suspended heel according to the preceding claims, **characterized in that** it includes a segment or complement in the hindfoot (8) that can be attached and removed as desired, in combination with the segment or complement of the midfoot (6).
7. The shoe with a suspended heel according to claim 6, **characterized in that** the segment or complement of the hindfoot (8) is formed by two superimposed parts (8').
8. The shoe with a suspended heel according to claims 6 and 7, **characterized in that** the hindfoot part (8) is made as a removable support complement (9).
9. A method for facilitating adaptation to the natural suspended heel running technique, **characterized by** comprising the following elements: a shoe (1) with a suspended heel, complements (6), (6'), (6''), (8), (8') for the shoe, high-speed chambers, force platforms and instrumented insoles.
10. The method for facilitating adaptation to the natural suspended heel running technique according to the preceding claim, **characterized in that** it comprises the following stages:

- Stage of familiarization: the person performs basic running, walking, climbing, leaping, receiving, jumping, falling and pushing off training exercises, as well as sprints and short-distance running at a constant or varied pace, using the shoe with a suspended heel without complements in the hindfoot region; there being no impact of the heel (hindfoot) on the ground at least 90% of the time and the measurement being taken with high-speed cameras or a force platform.

- Stage of integration: the person uses the shoe with a suspended heel without complements in the hindfoot region in sprints, in basic running, walking, climbing, leaping, receiving, jumping, falling and pushing off training exercises, either in a dynamic or static manner, in any direction, as well as short sprints and running at a constant or varied pace and while running continuously from 500 m to 2 km, whereas when running continuously for up to 5 km the person uses shoes with a suspended heel with the adaptation complements being inserted, generating less vertical movement of the heel during the support phase; the beginning of the plantar support during supination and contact with the region of the fifth metatarsal is measured by means of instrumented insoles, reaching a slight forward inclination of the torso of between 5° and 10°, the measurement being taken with high-speed cameras, and when running continuously for up to 2 km there is no impact of the heel (hindfoot) on the ground at least 90% of the time (the measurement being taken with high-speed chambers or a force platform).

- Stage of progression: the person runs continuously from 2 km to 5 km using the shoes with a suspended heel without complements in the hindfoot region, runs continuously for up to 8 km with the shoes with a suspended heel with adaptation complements, being able to start competing in trials of less than 2 km with the shoes with a suspended heel with adaptation complements; a negative phase below 5% of the total support is measured with high-speed chambers, the peak of the impact being reduced and measuring a position of plantar flexion of the foot at least 90% of the time, and there being no impact of the heel (hindfoot) on the ground when running continuously for up to 5 km at least 90% of the time (the measurement being taken with high-speed chambers or a force platform).

- Stage of adaptation: the runner runs continuously for up to 12 km using the shoes with a suspended heel with adaptation complements, performs interval training exercises of 200 m to 1.5 km with the shoes with a suspended heel without complements in the hindfoot region, runs competitively for less than 5 km with the

shoes with a suspended heel with adaptation complements; it is measured with high-speed chambers during the support phase that the foot remains at about 90° and does not touch the ground, whereas after a vertical jump using the shoes with a suspended heel, the heel continues to store elastic energy when the forefoot and/or the midfoot are supported in the anatomical position with respect to the ground at least 90% of the time, there being no impact of the heel (hindfoot) at least 90% of the time during anaerobic running for distances up to 400 m. In this stage, it is verified by means of high-speed chambers that the path of the foot before coming into contact with the ground is complete.

- Stage of consolidation: the person runs continuously for up to 30 min. with the shoes with a suspended heel without complements in the hindfoot region, performs interval training exercises of 200 m to 2 km with the shoes with a suspended heel without adaptation complements in the hindfoot region, runs continuously for up to 15 km using the shoes with a suspended heel with adaptation complements, runs competitively for up to 3 km with the shoes with a suspended heel without adaptation complements in the hindfoot region, runs competitively for up to 10 km with the shoes with a suspended heel with adaptation complements, measuring with high-speed chambers, instrumented insoles, accelerometers or a force platform a contact time below 150 ms, a 3% increase in stride length compared to the phase of integration, a 2% increase in support frequency compared to the phase of integration, and there being no impact of the heel (hindfoot) on the ground at least 90% of the time during anaerobic running for distances up to 1 km.

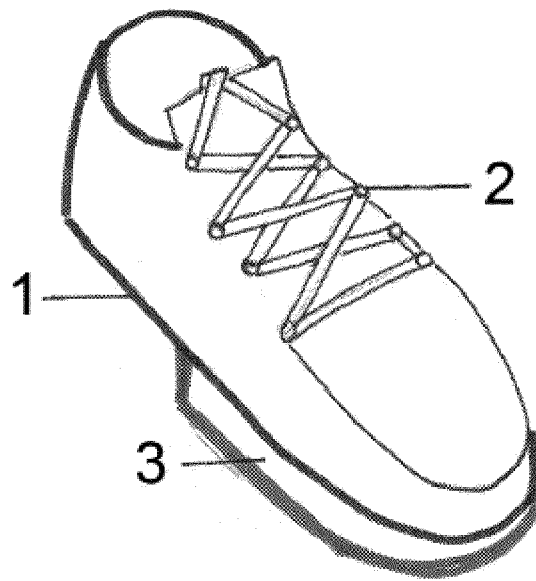


FIG. 1

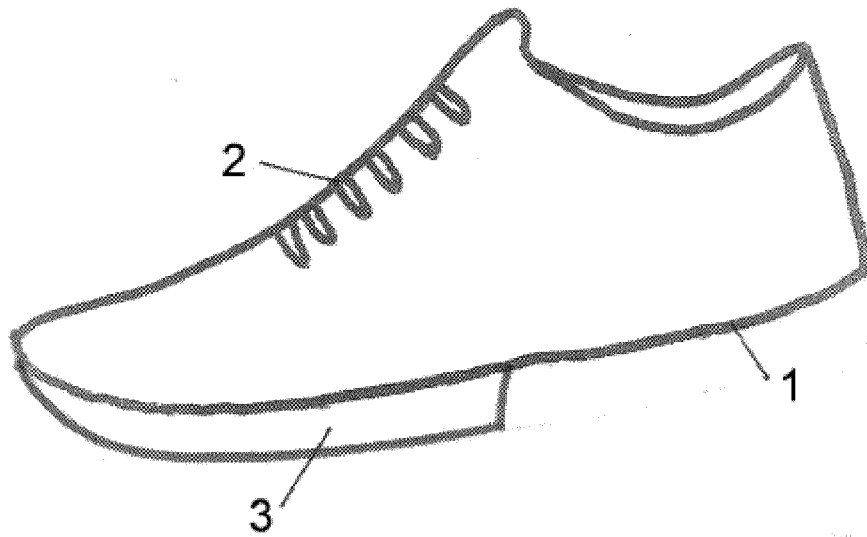


FIG. 2

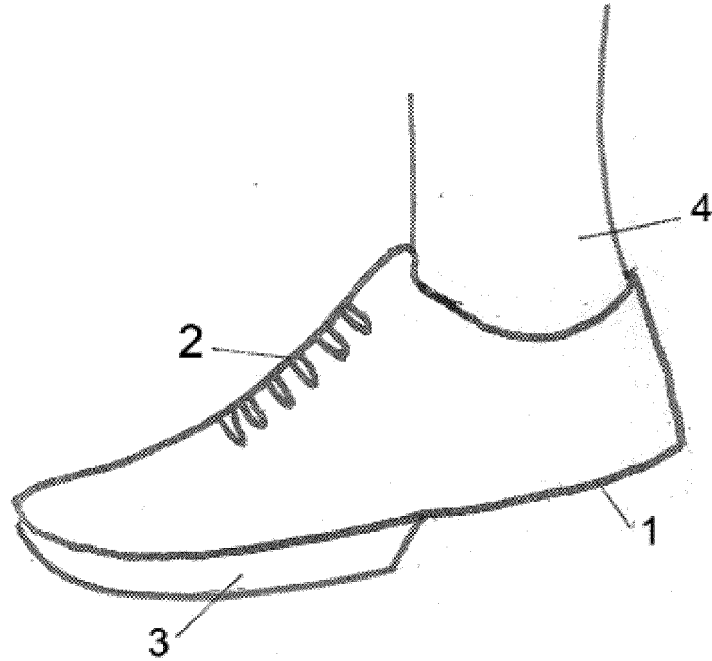


FIG. 3

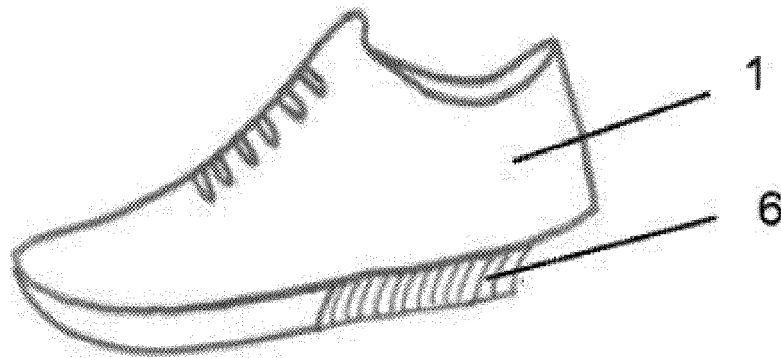


FIG. 4

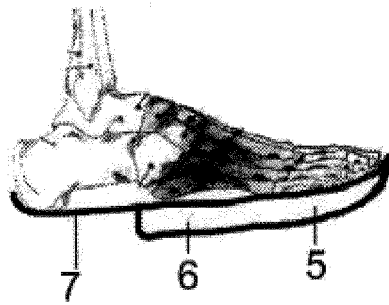


FIG. 5

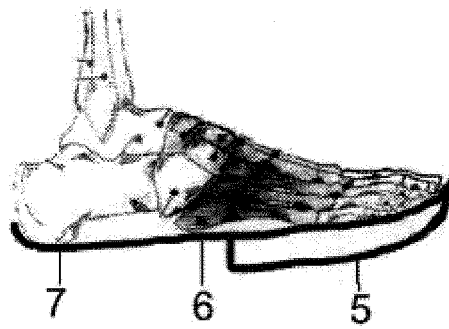


FIG. 6

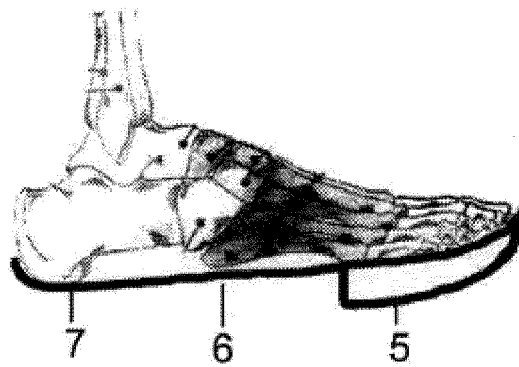


FIG. 7

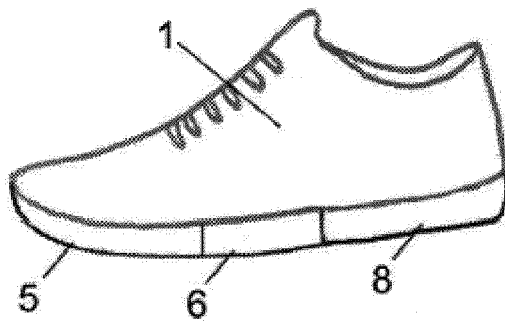


FIG. 8

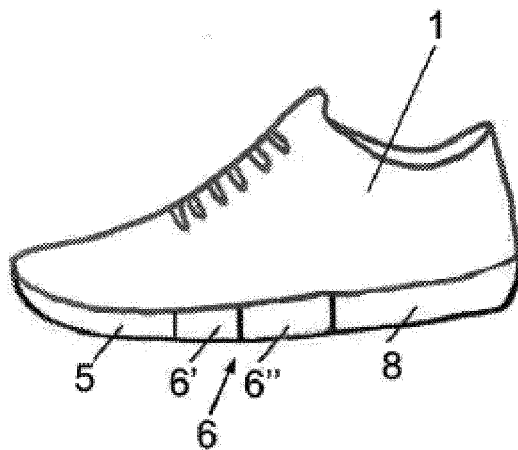


FIG. 9

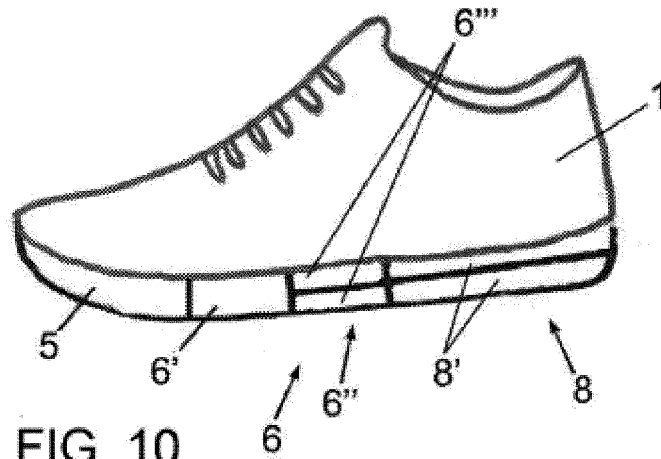


FIG. 10

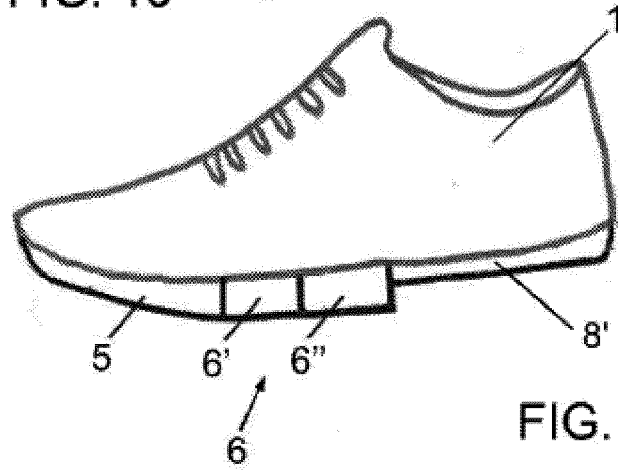


FIG. 11

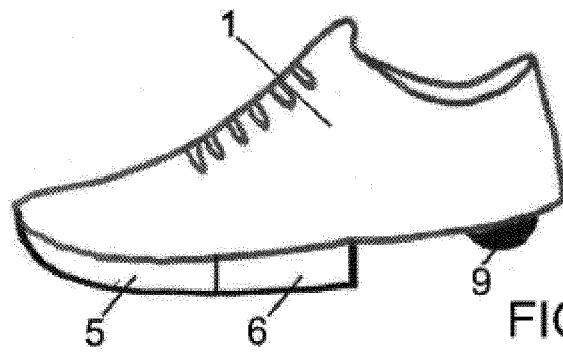


FIG. 12

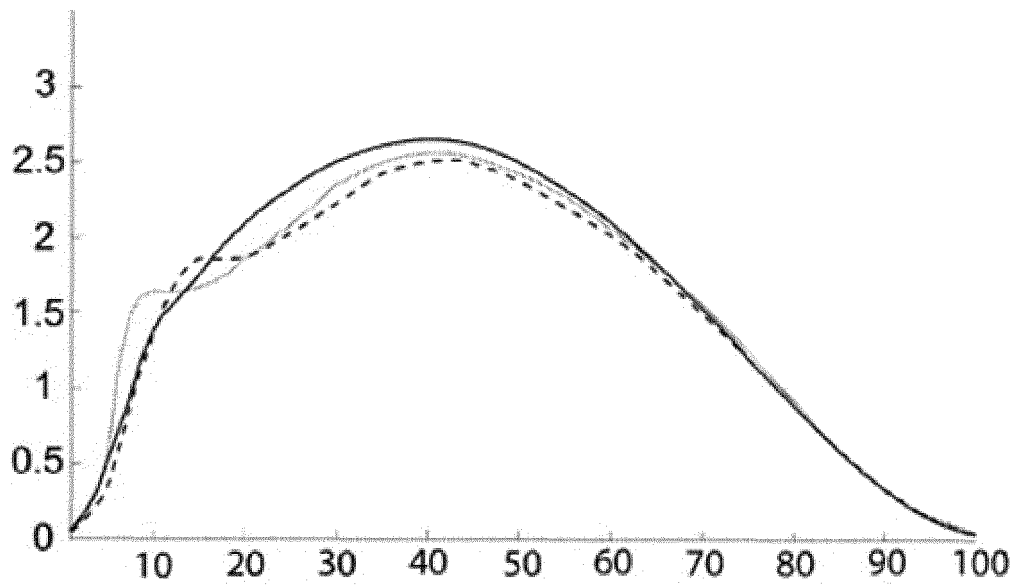


FIG. 13

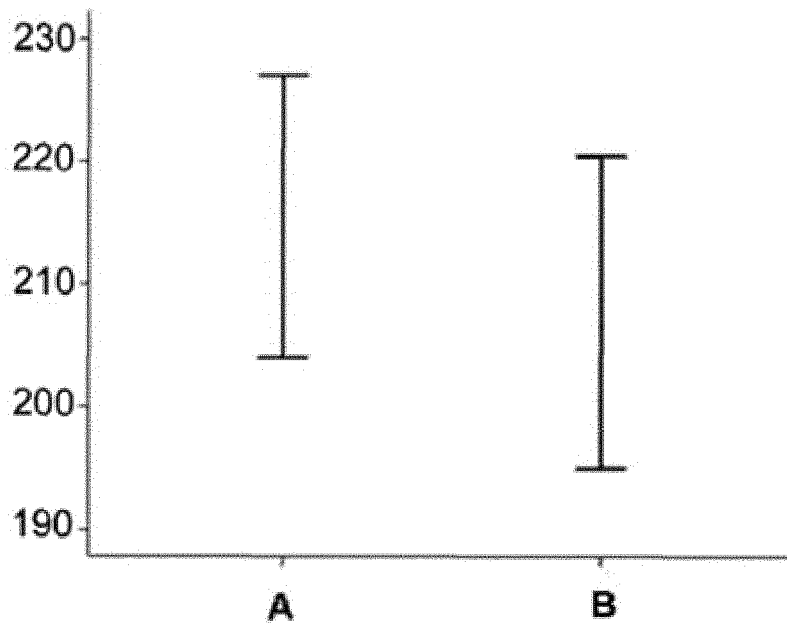


FIG. 14

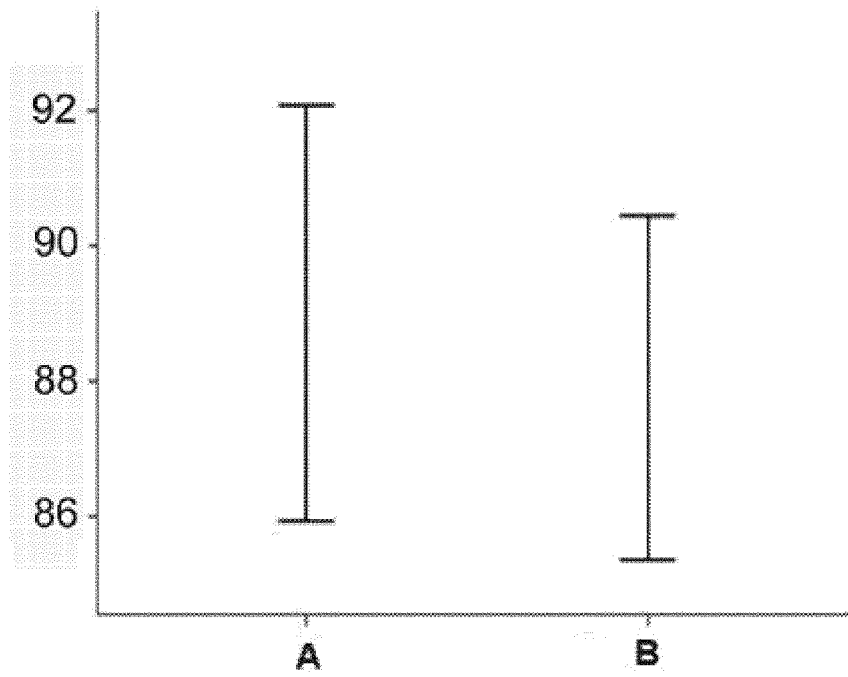


FIG. 15

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/ES2014/070792

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## A. CLASSIFICATION OF SUBJECT MATTER

A43B13/14 (2006.01)

A43B13/16 (2006.01)

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

## B. FIELDS SEARCHED

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Minimum documentation searched (classification system followed by classification symbols)

A43B

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

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

EPODOC, INVENES, WPI

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4949476 A (ANDERIE WOLF) 21/08/1990, abstract; column 1, lines 8 - 52; column 4, line 63 - column 5, line 60; figures 1, 3.	1
A		8
X	KR 20120095164 A (PARK YOUNG SOUL) 28/08/2012, Abstract from DataBase EPODOC. Retrieved of EPOQUE AN KR-20110014666-A	1
A		8
X	US 5694706 A (PENKA ETIENNE) 09/12/1997, abstract; figures 1, 3.	1

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 Further documents are listed in the continuation of Box C. See patent family annex.

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\* Special categories of cited documents:

"A" document defining the general state of the art which is not  
considered to be of particular relevance."E" earlier document but published on or after the international  
filing date"L" document which may throw doubts on priority claim(s) or  
which is cited to establish the publication date of another  
citation or other special reason (as specified)"O" document referring to an oral disclosure use, exhibition, or  
other means."P" document published prior to the international filing date but  
later than the priority date claimed"T" later document published after the international filing date or  
priority date and not in conflict with the application but cited  
to understand the principle or theory underlying the  
invention"X" document of particular relevance; the claimed invention  
cannot be considered novel or cannot be considered to  
involve an inventive step when the document is taken alone"Y" document of particular relevance; the claimed invention  
cannot be considered to involve an inventive step when the  
document is combined with one or more other documents,  
such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

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Date of the actual completion of the international search

09/12/2014

Date of mailing of the international search report

(12/01/2015)

Name and mailing address of the ISA/

OFICINA ESPAÑOLA DE PATENTES Y MARCAS

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Facsimile No.: 91 349 53 04

Authorized officer

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Telephone No. 91 3496860

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Form PCT/ISA/210 (second sheet) (July 2009)

## INTERNATIONAL SEARCH REPORT

International application No. PCT/ES2014/070792
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C (continuation).		DOCUMENTS CONSIDERED TO BE RELEVANT
Category *	Citation of documents, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 02060291 A1 (SYDNEY DESIGN TECHNOLOGIES INC ET AL.) 08/08/2002, page 5, lines 11 - 25; page 7, line 19 - page 8, line 2; page 9, line 21 - page 10, line 8; pages 15 - 18; figures.	1-2
Y		3-9
Y	WO 03103430 A1 (GLIDE N LOCK GMBH ET AL.) 18/12/2003, paragraphs [0012]; paragraphs [0021]-[0022], paragraphs [0037]-[0039], figure 8.	3-9
A	WO 2012112930 A1 (NIKE INTERNATIONAL LTD ET AL.) 23/08/2012, the whole document.	9
X	US 5829172 A (KANEKO YASUNORI) 03/11/1998, the whole document.	2

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

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**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

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1.  Claims Nos.: **10**  
because they relate to subject matter not required to be searched by this Authority, namely:

The subject matter of claim 10 in the application consists in a training method, and therefore it is not patentable because it is not industrially applicable (PCT Article 33(4)). Moreover, said claim fails to define a technical problem to be solved or the use of technical features, thereby contravening PCT Rule 6.3.

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2.  Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

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3.  Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

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**Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

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1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2.  As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

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- Remark on Protest**
- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

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INTERNATIONAL SEARCH REPORT

International application No.

Information on patent family members

PCT/ES2014/070792

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**INTERNATIONAL SEARCH REPORT**

International application No. PCT/ES2014/070792
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