



(51) International Patent Classification:

A43B 7/18 (2006.01) A43B 23/02 (2006.01)
A43B 13/40 (2006.01) A43C 11/00 (2006.01)

(21) International Application Number:

PCT/CZ2018/050007

(22) International Filing Date:

21 February 2018 (21.02.2018)

(25) Filing Language:

Czech

(26) Publication Language:

English

(30) Priority Data:

CZ PV 2017-106 24 February 2017 (24.02.2017) CZ

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,

OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

- with international search report (Art. 21(3))
- in black and white; the international application as filed contained color or greyscale and is available for download from PATENTSCOPE

(54) Title: FOOTWEAR

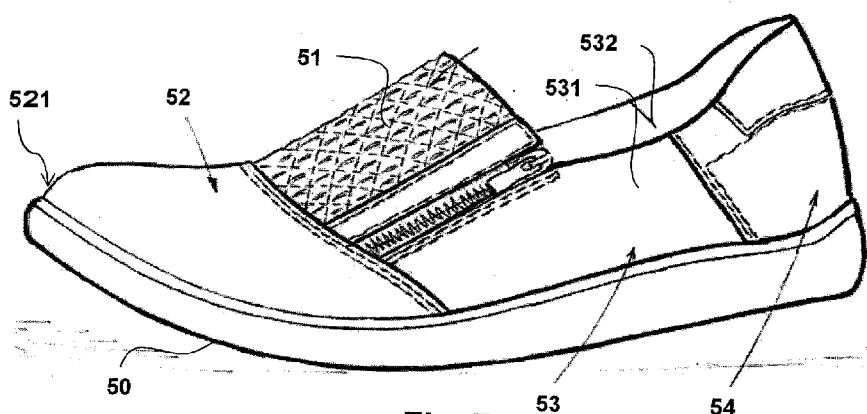


Fig. 7

(57) Abstract: The invention relates to footwear comprising an active biomechanical insole (1) mounted on an outsole (50), to which an upper (5) of the footwear is attached. Pretensioned lateral segments (53) are arranged in the upper (5) of the footwear between the front toe portion (52) of the upper of the footwear and the heel portion (54) of the upper of the footwear on either lateral side of the footwear, whereby the pretensioned lateral segments (53) attract the front toe portion (52) of the upper of the footwear and the heel portion (54) of the upper of the footwear to each other.



Footwear

Technical field

The invention relates to footwear comprising an active biomechanical
5 insole arranged on an outsole to which an upper of the footwear is attached.

Background art

WO2013/123922 (CZ PV 2012-132) describes a shoe comprising an
outsole to which an upper of the shoe is attached and on whose upper side an
10 insole is arranged. The upper of the shoe in the area of the instep of the foot
comprises at least one elastic instep insertion which reduces the pressure of the
shoe upper on the instep of the foot and the insole comprises on its upper side
at least a depression for the big toe joint and a depression or lowering for the
heel bone.

15 The shoe according to CZ PV 2012-132 is based on synergistic effects of
several elements. The first of the elements is an insole, which is arranged in the
shoe rigidly (stiffening insole) or removably (insertable insole), depending on
requirements, and which on its upper side comprises at least a depression for
the big toe joint and a depression for the heel bone. Thanks to these
20 depressions, this insole maintains the foot in a natural position and facilitates to
properly distribute the weight of the human body among its main support points,
consisting of the big toe joint, the toe joints and the heel bone. Furthermore, the
lowering of the heel bone helps to achieve the correct position of the whole
lower limb, thus not only unloading the parts which have been over-loaded,
25 especially the ligaments and joints, but also unloading the spine and thereby
straightening the body posture and moving the center of gravity to its natural
position. In various embodiments, alongside with depressions for the big toe
joint and the heel bone, the insole may be provided with additional elements,
such as a protrusion for support of the longitudinal arch, etc. Another element of
30 the shoe according to CZ PV 2012-132, which closely cooperates with the
insole, is at least one flexible insert made of an elastic material, which is
incorporated in the upper of the shoe in an area which comes in contact with the

instep of the foot and which with advantage extends, depending on the type of shoe, up to the edge of the instep, or to the hole in the shoe, or to the transition of the instep of the shoe to the middle or the rear section of the upper of the shoe.

5 Despite the undisputable advantages of this footwear design, it has been found out that neither an elastic instep insert, nor an elastic ankle insert acts on the foot sufficiently, especially at rest, that is, during sitting, driving a car, standing without walking, etc.

Therefore, the aim of the invention is to propose footwear which would
10 act on the foot in combination with the active biomechanical insole also at rest.

Principle of the invention

The aim of the invention is achieved by footwear comprising an active biomechanical insole according to the invention, whose principle consists in that
15 pretensioned lateral segments are provided in the upper of the footwear between the front toe portion of the upper of the footwear and the heel portion of the upper of the footwear on either lateral side of the footwear, whereby the pretensioned lateral segments attract the front toe portion of the footwear upper and the heel portion of the footwear upper to each other.

20 After putting on the footwear according to the invention, the pretensioned elastic lateral segments are stretched and the front toe portion of the footwear is straightened. Consequently, the toe cap drops down and the outsole is straightened. The foot in the footwear rests on the unillustrated active biomechanical insole and is pressed to it by the forces exerted by the elastic lateral segments both in rest position, i.e. when sitting, driving a car etc., and
25 also when walking in an unloaded position, while the other foot is in contact with the floor and the unloaded foot is moving to get into contact with the floor, the instep being unloaded. Thus, the synergistic effect of the insole and the footwear occurs in all the phases of using the footwear, namely at rest, during
30 sitting or driving, but also when walking, whereby the synergistic effect is ensured also in the phase of raising the foot from the floor, which means that the foot is moving to be placed again on the ground.

Considering the prior art, it is advantageous if in the area of the instep of the foot an elastic instep insert is incorporated in the upper of the footwear between the front toe portion and the two pretensioned lateral segments.

5 In another alternative embodiment, it is advantageous if the front toe portion of the upper of the footwear extends up to the instep area and is made of an elastic material capable of deformation at least upwards from the lateral sides of the outsole.

Further improvement is achieved if the elastic material is capable of deformation in all directions, which significantly unloads the foot instep and, together with the pretensioned lateral segments, acts in the direction of attraction of the front toe portion or, in other words, the toe cap, towards the heel portion.

Description of drawings

15 The footwear according to the invention will be described in greater detail by means of drawings, wherein Fig. 1 is a view of an active biomechanical insole from above, Fig. 2 is a cross-section VII-VII through the insole according to Fig. 1, Fig. 3 is a cross-section VIII-VIII through the insole according to Fig. 1, Fig. 4 shows a view of the shoe according to CZ PV 2012-132 with an elastic instep insertion, Fig. 5 shows the function of the foot when standing on the active biomechanical insole, Fig. 6 shows the function of the foot without an active biomechanical insole when standing, Fig. 7 shows the footwear with the upper according to the invention without a foot placed in it, Fig. 8 represents the footwear of Fig. 7 with a foot placed in it, Fig. 9 shows the footwear according to the invention with the entire front toe portion made of an elastic material without a foot placed in it and Fig. 10 represents the footwear of Fig. 9 with a foot placed in it.

Examples of embodiment

30 The footwear according to the invention is based on the synergistic effect of several systems.

The first of them is an active biomechanical insole 1 created according to CZ patent 298894 (corresponding European application EP 1854371), improved according to CZ PV 2009-580 (corresponding applications RU 2558344, WO2011/023148). The second system consists of an upper 5 of the footwear, which in the area of the instep of the foot comprises at least one elastic insert 51, which reduces the pressure of the upper 5 of the footwear on the instep of the foot.

The active biomechanical insole 1 comprises a bottom supporting layer 2, made of pressed cork mixture, on which is mounted an intermediate layer 3, typically made of an elastic material, which is covered from the top with a cover layer 4, which is in contact with the sole of the foot. From the bottom side 100 the active biomechanical insole 1 has a shape of the bottom part of the human foot (the sole) with a planar toe portion and from the upper side a shape of an impression of the bottom part of the human foot with a planar toe portion 6. The bottom side 100 of the insole comprises in the heel portion a heel protrusion 121 arranged beneath the heel depression 12 on the upper side of the insole, which is delimited on the outside by deflection 131 of the cubic bone arranged beneath the support 13 of the cubic bone on the upper side of the insole and which is joined by a protrusion 101 of the longitudinal metacarpal bone arranged beneath the depression 10 of the longitudinal metacarpal bone on the upper side of the insole. Adjacent to the protrusion 101 of the metacarpal bone is a protrusion 81 of the little toe joints arranged beneath the depression 8 of the little toe joints on the upper side of the insole, which runs via the deflection of the support 78 of the transverse arch towards the inner part of the insole to the protrusion 71 of the big toe joint, arranged beneath the depression 7 of the big toe joint on the upper side of the insole. Moreover, the support 78 of the transverse arch constitutes a flexible bridge between the section of the insole beneath the big toe joint and that beneath little toe joints. Adjacent to this support 78 towards the heel portion 11 of the insole is the support 9 of the longitudinal arch of the foot, which is from the bottom side of the insole formed by deflection 91 of the support of the longitudinal arch arranged beneath the support 9 of the longitudinal arch of the foot on the upper side of the insole. The active biomechanical insole maintains the foot in a natural position and

contributes to proper distribution of the human body weight among its main supporting points consisting of the big toe joint, the toe joints and the heel bones. The shaping of the bottom part of the insole in the above-mentioned manner helps to support the soft tissues of the foot and in the event of a higher physical effort, the foot is not overloaded at the point of support by excessive force applied to the soft tissues, but it allows the foot to retreat and, with reduced effort, returns to its original position.

In the embodiment according to CZ patent application 2009-580, or corresponding international patent application WO 2011023148, the heel portion 11 of this active biomechanical insole 1 with a heel depression 12 is further lowered with respect to the middle portion of the insole 1 by means of a depression or lowering, which is not illustrated in the drawings accompanying this application. Thanks to this arrangement, the user's heel was placed below the level of the other parts of the foot, which during static loading results in partial tightening of the user's heel, causing Achilles tendon and other muscles and tendons connected to it being loaded, and, on the contrary, reducing the load of the muscles and tendons of the foot located opposite Achilles tendon, as shown in Fig. 1A. Due to this, the load of all the muscles and tendons involved is distributed naturally and evenly, so that the wearer's foot and ankle and thereby also the knee and hip are held in a natural position without being deflected from the axis, or, in other words, are verticalized by the action of the forces between the muscles and the tendons.

The function of the foot with an active biomechanical insole 1 during standing is schematically represented in Fig. 5, where the insole itself is not illustrated, to show distinctly the contours of the individual bones of the foot. The arrows indicate the directions of the force applied by the active biomechanical insole to the individual parts of the foot. The arrow A indicates the function of the extensor of the big toe and other toes as a result of positioning the big toe joint in the depression of the big toe joint and the arrow B indicates the function of the big toe and other toes caused by the same. The function of a rigid lever is fully activated and is schematically indicated by the arrow AB. The arrows C and D indicate plantar and dorsal flexion of the instep in the directions given to humans by nature. The arrow H indicates the direction of Achilles tendon, which

is due to the heel being positioned in the lowered heel depression pulled forward in the direction of the arrows G. The arrows E and F indicate the forces which act on the arch of the foot in the direction away from the insole and lift the arch. The arrow J points at the point of the lowering of the heel depression in the insole.

For comparison, Fig. 6 shows a skeleton of the foot placed in footwear without an active biomechanical insole. The arrow AX indicates a malfunctioning extensor of the big toe and other toes caused by the fact that both the toe joints and the big toe joint are positioned in the same plane. The arrow BX indicates a flexor of the big toe and other toes, whose malfunction is due to the same reason. The function of a rigid lever indicated by the arrow ABX is completely suppressed. The arrow KX indicates the area where hammer toes can be formed. The arrows CX and DX show plantar and dorsal flexion of the instep, which is reversed compared to the active biomechanical insole. As the heel is positioned in the same plane as both the toe joints and the big toe joint, the heel is acted upon by a force in the direction of the arrows GX rearward from the toe joints and Achilles tendon is therefore loosened up, as is indicated by the arrow HX.

With further development, the applicant has found out that the positive properties of the active biomechanical foot 1 with a lowered heel are reduced by a shoe with a rigid instep and therefore proposed a shoe in CZ PV 2012-132, shown in Fig. 4, whose upper 5 includes in the area of the instep of the foot at least one elastic instep insert 51, which reduces the pressure of the shoe upper on the instep of the foot, and, in particular, during walking it further improves the engagement of the muscles and tendons of the foot, ankle, the whole leg and body of the user, as has been mentioned in the chapter „Background art“. The elastic instep insert 51 is incorporated above the front toe portion 52 of the footwear and between adjacent lateral segments 53, which are in the rear connected by means of the heel portion 54. The outsole 50 of this footwear is straight in rest position, in the same manner as in the position when the shoe is placed on the user's foot. The front toe portion 51, lateral segments 53, as well as the heel portion 54, are made of leather or non-stretch fabric.

Despite the undoubted advantages of this footwear design, it has been found out that the effect of the elastic instep insert on the foot sole is not sufficient especially in rest position, that is during sitting, driving, standing etc., and its benefits are manifested especially when walking.

5 Therefore, after further research and development, the applicant has recognized the need for a force interaction between the front toe portion and the heel portion of the footwear. This was accomplished by the creation of lateral segments of the footwear made of an elastic material.

The footwear according to Figs. 7 and 8 comprises an active
10 biomechanical insole described above (not shown in these drawings), mounted on an outsole 50, to which the upper 5 of the footwear is attached. The upper 5 of the footwear is formed by a front toe portion 52, which is joined in the instep area by an elastic instep insert 51. On either lateral side of the elastic instep insert 51 are arranged in the upper 5 of the footwear pretensioned elastic lateral
15 segments 53, which consist of an outer pretensioned elastic lateral segment 531 and an inner pretensioned elastic lateral segment 532, which are connected to the front toe portion 52 at the front, to the rear heel portion 54 in the rear and to the outsole 50 at the bottom. In the illustrated embodiment, a zip, which serves to loosen the elastic instep insert 51 when putting on the
20 footwear, is inserted on the outer side of the footwear between the elastic instep insert 51 and the outer pretensioned elastic lateral segment 531. With sufficient elasticity of the elastic instep insert 51, the zip can be omitted. The pretensioned elastic lateral segments 53 are shorter when contracted than the distance between their engagement with the front toe portion 52 and the rear
25 heel portion 54 with the foot placed in the shoe, therefore in an empty shoe without a foot placed in it, the pretensioned elastic lateral segments 53 attract the front toe portion 52 towards the rear heel portion 54, which results in raising the toe cap 521 of the front toe portion 52 upward. If the elastic lateral segments are provided with a lining inside the footwear, the length of the lining is at least
30 the same as that of an elastic lateral segment in an expanded state. The pretensioned elastic lateral segments 53 in the exemplary embodiment are made of a stretch material with reduced water wettability, for example lotus

flower fabric, which reduces their water wettability, or they can be made of a water-impermeable material.

The force interaction between the front toe portion 52 of the footwear and the heel portion 54 of the footwear can be achieved even without using an elastic instep insert 51 merely by incorporating pretensioned elastic segments between the front toe portion 52 of the footwear and the heel portion 54 of the footwear, which is not illustrated, but to a person skilled in the art it is obvious that this is an alternative of the arrangement of the upper 5 of the footwear according to the invention.

After putting on the footwear, as shown in Fig. 8, the pretensioned elastic segments 53 expand and the front toe portion 52 of the footwear is straightened, and consequently, the toe cap 521 drops down and the outsole 50 is straightened. The foot in the footwear rests on the active biomechanical insole (not shown) and is pressed to it by the forces exerted by the elastic lateral segments 531, 532 both in rest position, i.e. during sitting, driving etc. and also during walking in an unloaded position, when the other foot is in contact with the floor and the unloaded foot is moving to come into further contact with the floor, whereby the instep is unloaded and the force applied to it by the elastic instep insert 51 is minimal. Thus, the synergistic effect of the insole and the footwear occurs in all the phases of wearing the footwear, namely during rest while sitting or driving, as well as during walking, whereby the synergistic effect is ensured during raising the foot from the floor, that is to say when the foot is moving to be placed again on the floor.

As a result, kinetic energy that you perceive is created. It is important for a human organism to create muscle mass in flexion and extension, when this action starts from the foot and passes through the body. This saves body wear and the energy that the human body needs to function and move. Shoe usage has a direct effect on blood flow and oxygenation, improving blood circulation and improving heart activity. Also important is the effect on the activation of the lymphatic system, which carries harmful substances away from the body. The footwear according to the invention in synergy with the active biomechanical insole supports and stimulates the proper functioning of the transverse and longitudinal arches of the foot, the broad tendon of the heel, the perfect function

of Achilles tendon, which is attached to the triceps surae and the quadriceps muscles of the leg. Synergistic effect of the footwear according to the invention and of the active biomechanical insole promotes the activity of the rigid lever of the big toe, which plays one of the crucial roles in the foot function.

5 During the gait when wearing conventional footwear without an active biomechanical insole and without the arrangement of the upper of the footwear according to the invention, the left or right brain hemisphere, depending on the foot, must balance the forces acting on the shoe user, because in the raised position of the foot there are no forces in the footwear acting on the user's sole, 10 whereas the foot which is in contact with the floor reflects the weight of the footwear user's entire body. The same is true when using an active biomechanical insole in conventional footwear without adjustments of the upper according to the invention.

On the contrary, the use of the active biomechanical insole in the 15 footwear with an upper according to the invention, results in the synergistic effect of the active biomechanical insole and forces induced by the stretching of the pretensioned elastic lateral segments 53 due to the user's foot being inserted into the footwear, as shown in Fig. 8. The forces induced by stretching the pretensioned elastic lateral segments 53 continue to operate as long as the 20 foot is in the footwear, regardless of whether it is a foot on which rests the whole weight of the wearer, or a foot in a raised position, which is not loaded by the weight of the body.

An alternative embodiment of the footwear according to the invention is represented in Figs. 9 and 10, wherein the front toe portion 52 is made of an 25 elastic stretch material and extends as far as above the instep of the foot, thus substituting the elastic instep insert from the preceding solution. Pretensioned elastic lateral segments 351 and 352 are connected on either side of the footwear to the front toe portion 52 made from an elastic stretch material and on the rear side are attached to the heel portion 54.

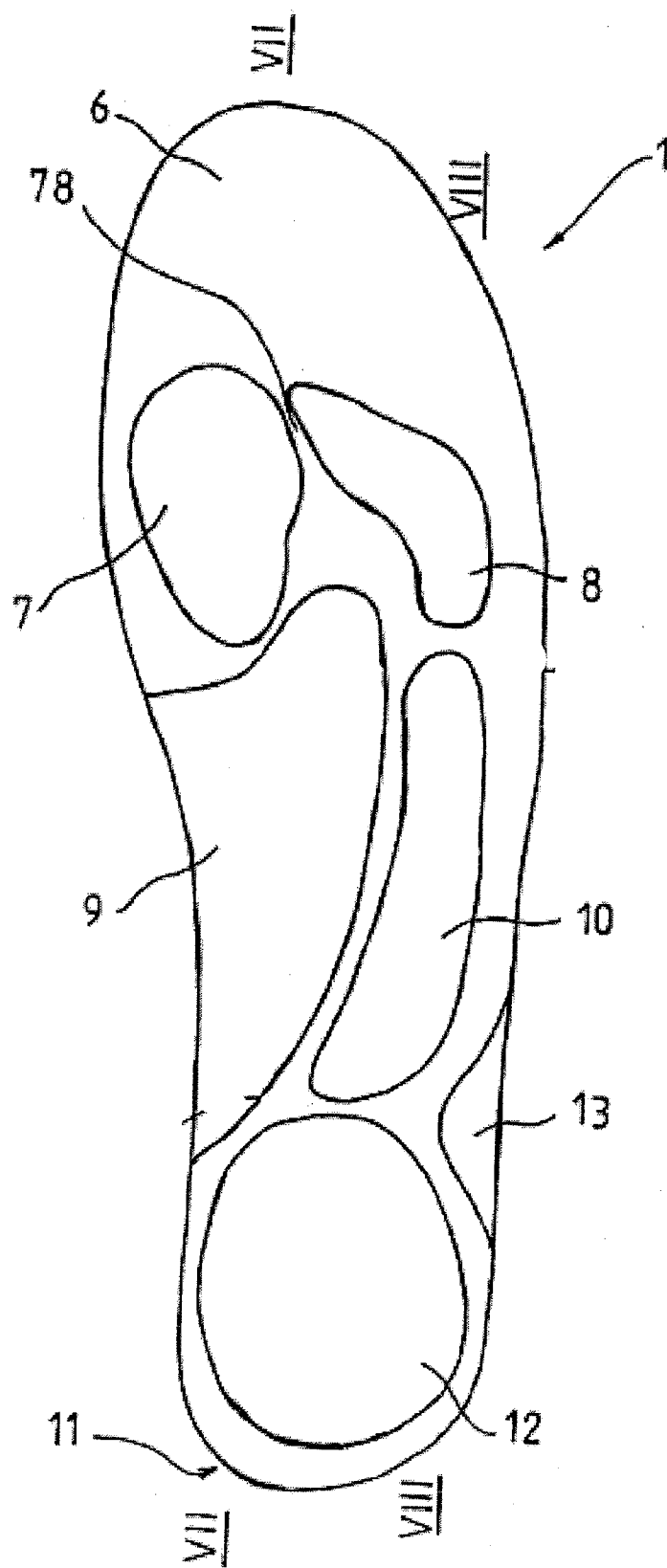
30 The function of this embodiment is similar to the preceding embodiment, except that the instep of the wearer's foot in the footwear is even more relaxed in the required directions.

List of references

- 1 active biomechanical insole
- 100 bottom side of the active biomechanical insole
- 5 2 supporting layer of the insole
- 3 intermediate layer of the insole
- 4 cover layer of the insole
- 5 upper of the footwear
- 50 outsole of the footwear
- 10 51 elastic instep insert incorporated in the upper of the footwear
- 52 front toe portion of the upper of the footwear
- 521 toe cap
- 53 lateral part of the upper of the footwear
- 531 outer lateral part
- 15 532 inner lateral part
- 54 heel portion of the upper of the footwear
- 6 smooth toe portion of the insole
- 7 depression of the big toe joint
- 5 271 protrusion of the big toe joint
- 20 78 support of the transverse arch
- 8 depression of the little toe joints
- 81 protrusion of the little toe joints
- 9 support of the longitudinal arch of the foot
- 10 91 deflection of the support of the longitudinal arch of the foot
- 25 10 depression of the metatarsal bone
- 101 protrusion of the metatarsal bone
- 11 heel portion of the insole
- 12 heel depression
- 15 121 heel protrusion
- 30 13 support of the cubic bone
- 131 deflection of the cubic bone

PATENT CLAIMS

1. Footwear comprising an active biomechanical insole arranged on an outsole (50), to which an upper (5) of the footwear is attached, **characterized in**
5 **that** pretensioned elastic lateral segments (53) are arranged in the upper (5) of the footwear between the front toe portion (52) of the upper of the footwear and the heel portion (54) of the upper of the footwear on either lateral side of the footwear, attracting the front toe portion (52) of the upper of the footwear and the heel portion (54) of the upper of the footwear to each other.
- 10 2. The footwear according to claim 1, **characterized in that** an elastic instep insert (51) is incorporated in the area of the instep of the foot between the front toe portion (52) and the two pretensioned lateral segments (53) of the upper of the footwear.
- 15 3. The footwear according to claim 1, **characterized in that** the front toe portion (52) of the upper of the footwear extends up to the area of the instep of the foot and is made of an elastic material capable of deformation at least upwards from the lateral side of the outsole.
- 20 4. The footwear according to claim 3, **characterized in that** the elastic material of the front toe portion (52) of the footwear is capable of deformation (expanding and contracting) in all directions.
5. The footwear according to claim 2, **characterized in that** the front toe portion (52) of the footwear and the elastic instep insert (51) are made from one piece of an elastic material.

**Fig. 1**

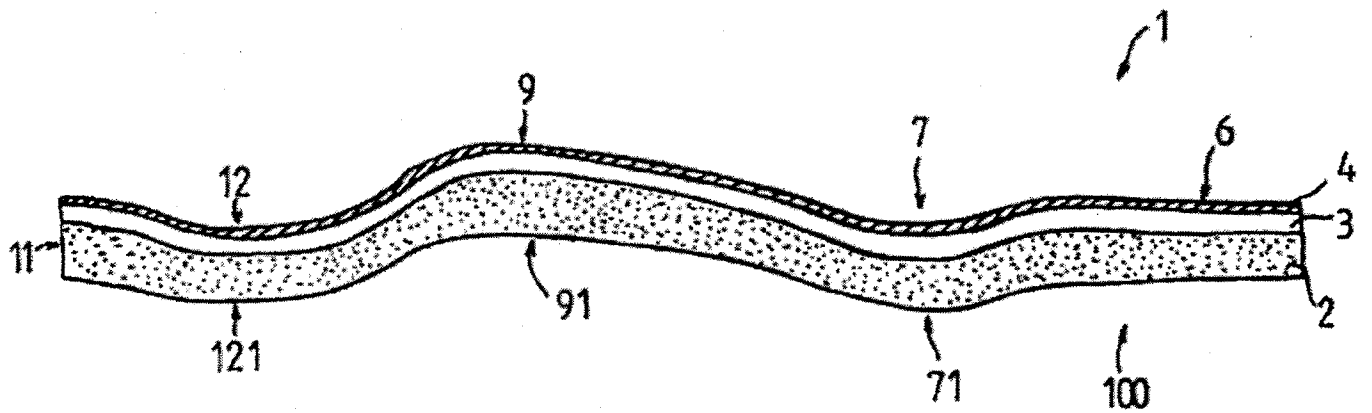


Fig. 2

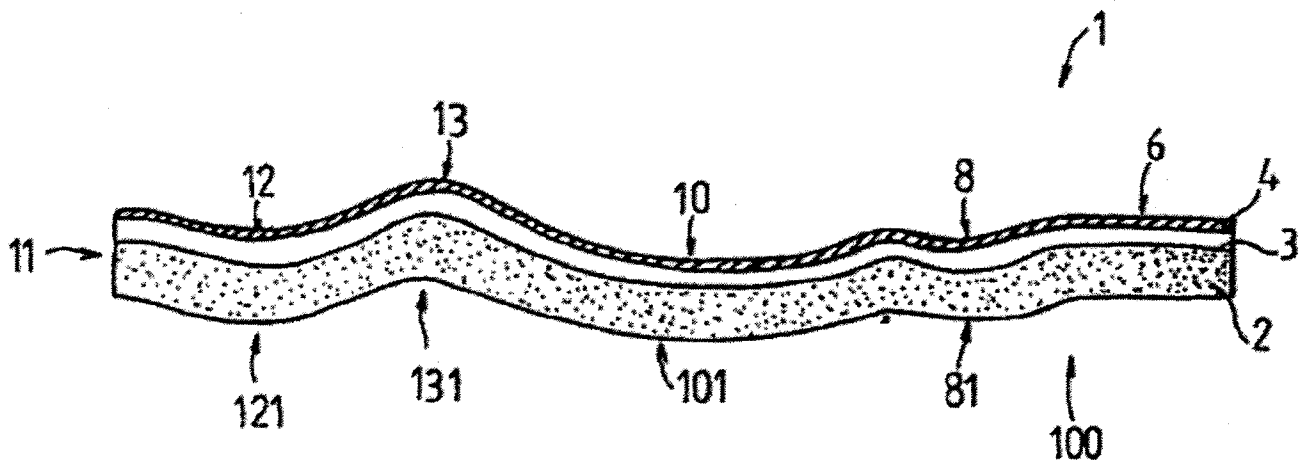


Fig. 3

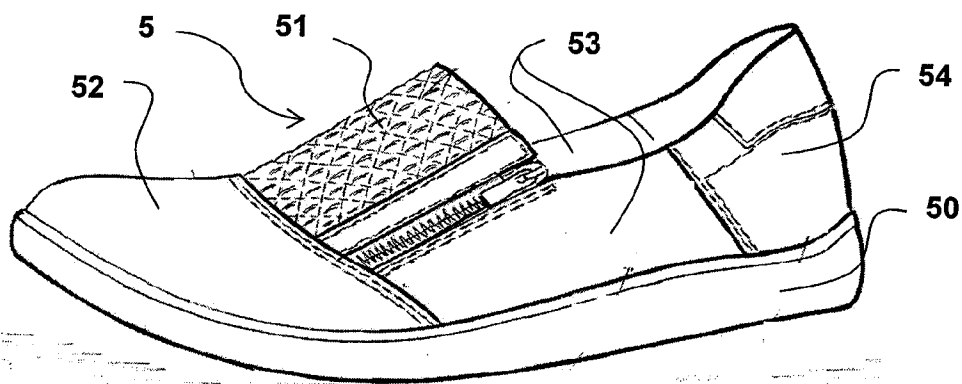


Fig. 4

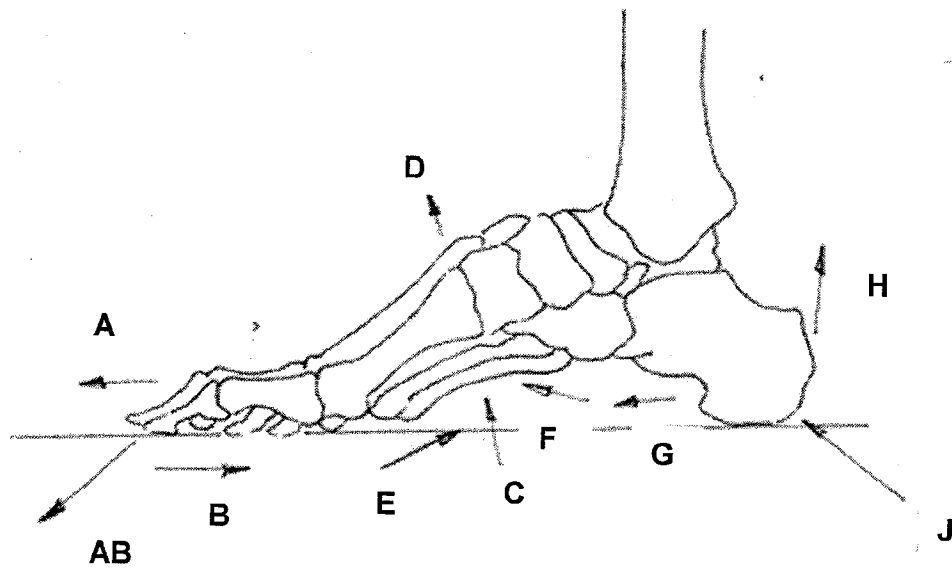


Fig. 5

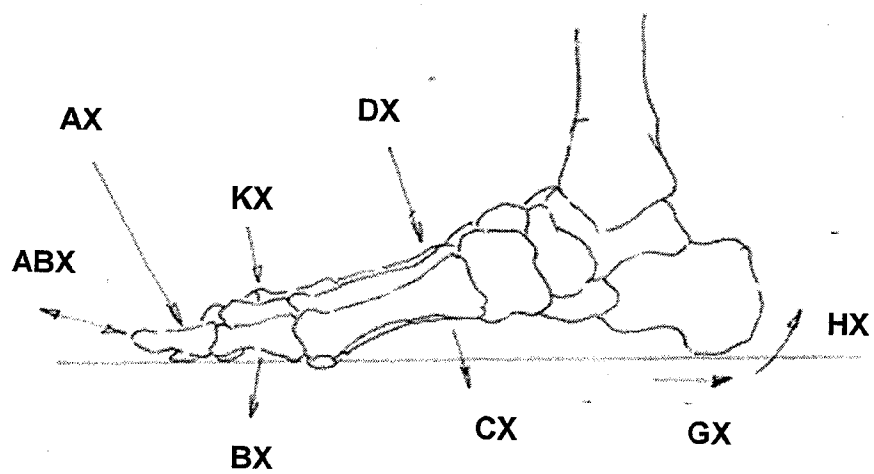


Fig. 6

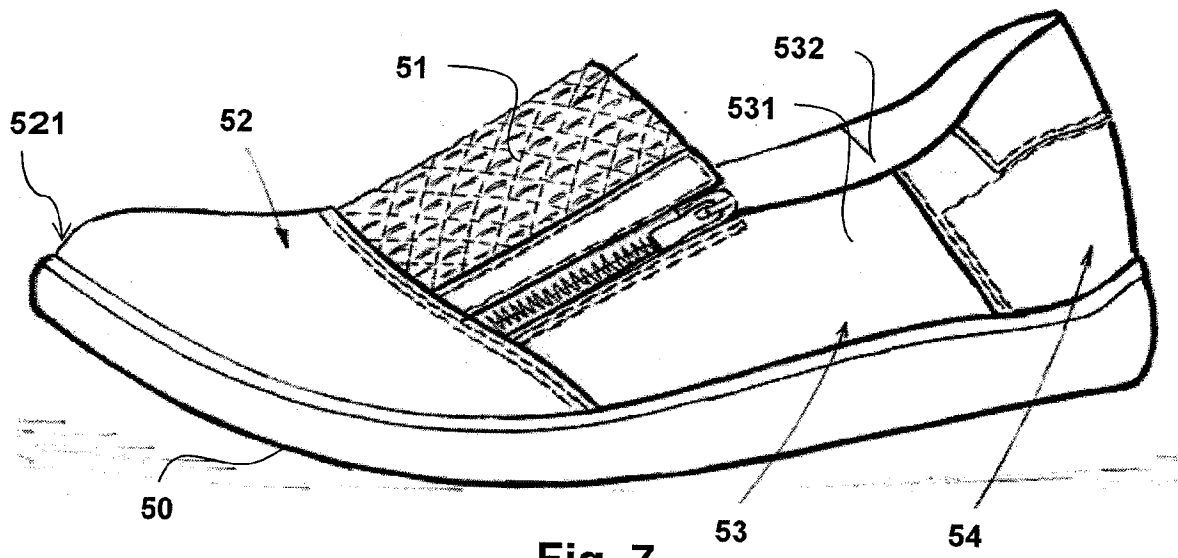


Fig. 7

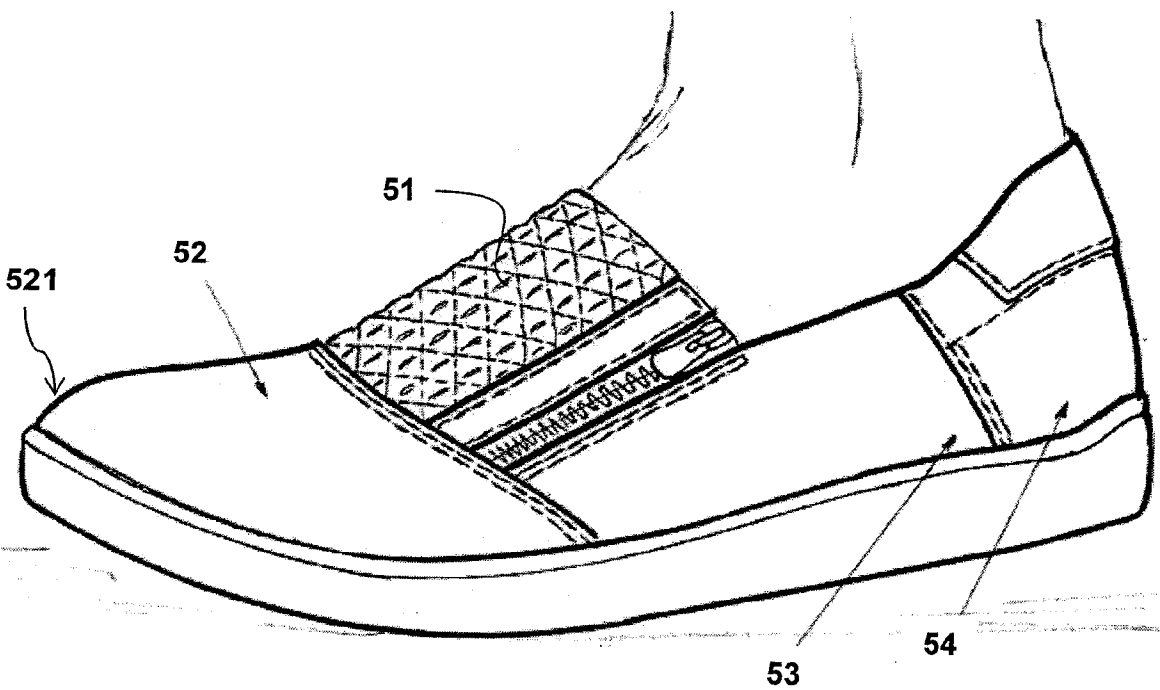


Fig. 8

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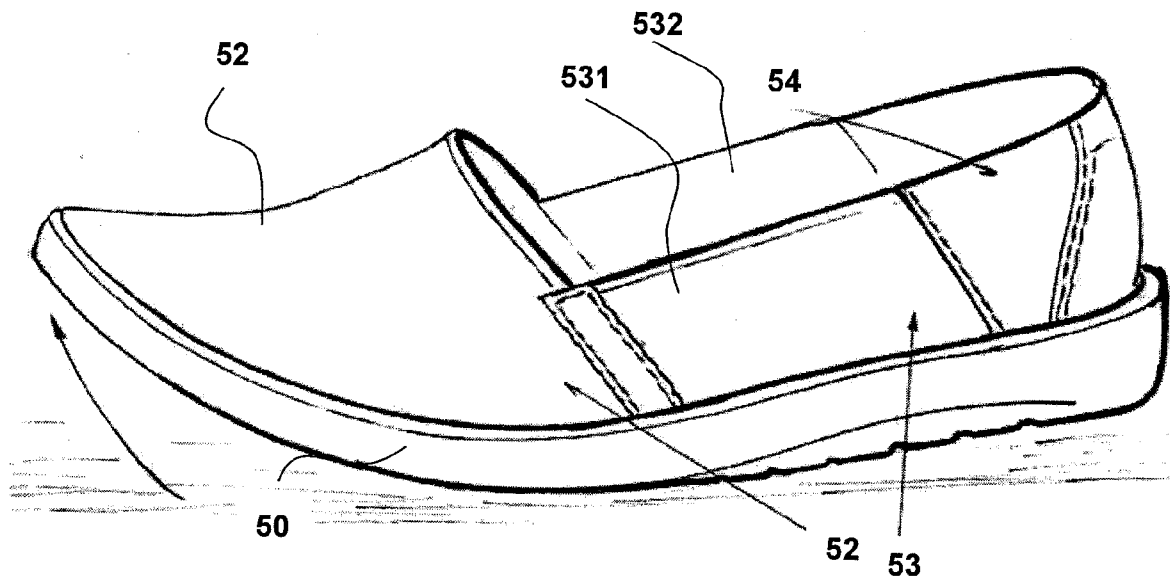


Fig. 9

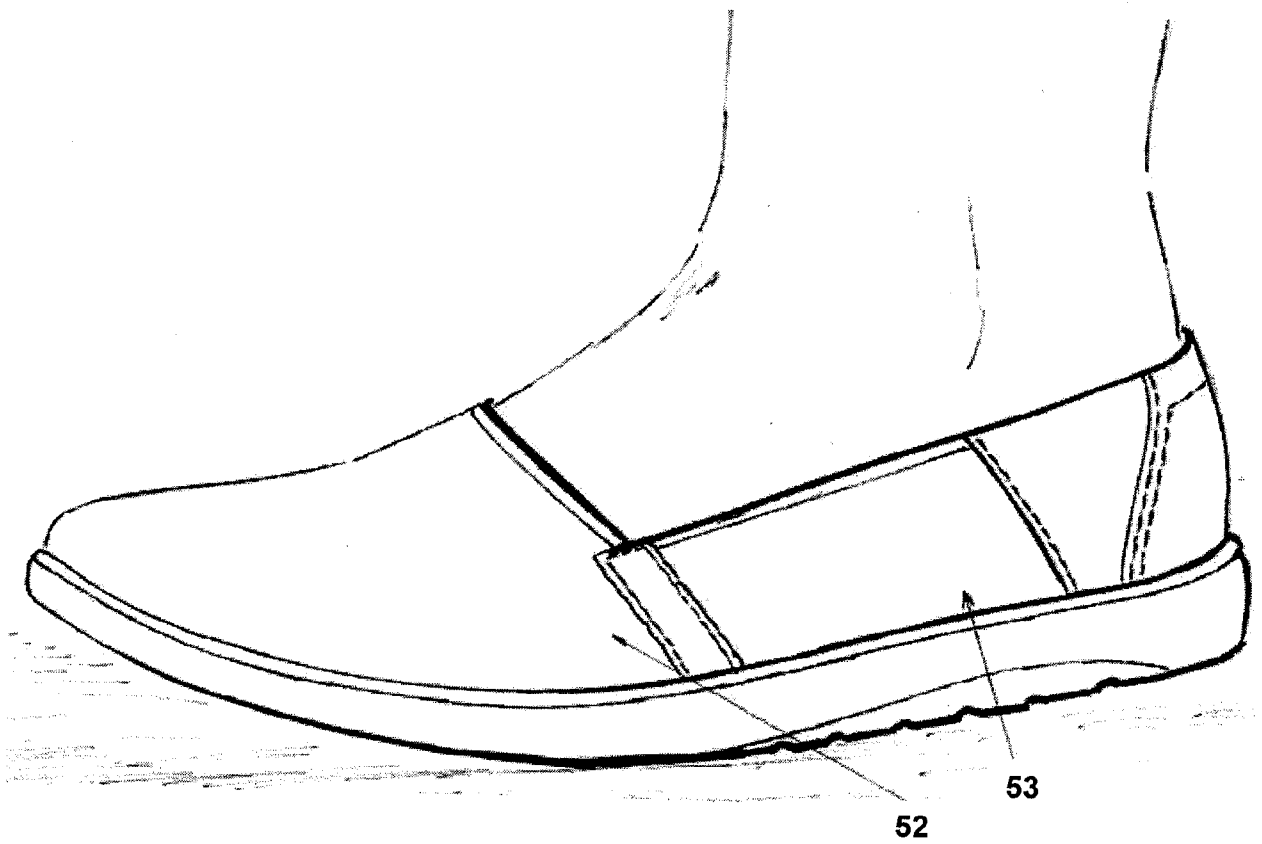


Fig. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/CZ2018/050007

A. CLASSIFICATION OF SUBJECT MATTER
INV. A43B7/18 A43B13/40 A43B23/02 A43C11/00
ADD.

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 A43C

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)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2013/123922 A1 (BOTY J HANAK R S R O [CZ]; UNIV MASARYKOVA [CZ]) 29 August 2013 (2013-08-29)	1
Y	figures 9, 10 page 10, line 13 - line 16 page 10, line 30 - line 31	2-5
Y	----- US 2002/078591 A1 (MORRONE PETER [US]) 27 June 2002 (2002-06-27)	2
A	figure 1 -----	1
Y	US 2002/166257 A1 (WILKINSON WILLIAM T [US]) 14 November 2002 (2002-11-14)	2-4
A	figure 1A paragraph [0025] ----- -/-	1



Further documents are listed in the continuation of Box C.



See patent family annex.

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"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

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Date of the actual completion of the international search

22 May 2018

Date of mailing of the international search report

29/05/2018

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No
PCT/CZ2018/050007

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2011/023148 A2 (HANAK JOSEF [CZ]) 3 March 2011 (2011-03-03) the whole document	1-5
Y	----- US 2 158 153 A (ROBERTS EDWARD F ET AL) 16 May 1939 (1939-05-16) the whole document	5
Y	----- US 1 961 910 A (PIKE STANLEY I) 5 June 1934 (1934-06-05) the whole document	5
Y	----- DE 10 30 734 B (ALAN ETCHISON MURRAY) 22 May 1958 (1958-05-22) the whole document	5
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