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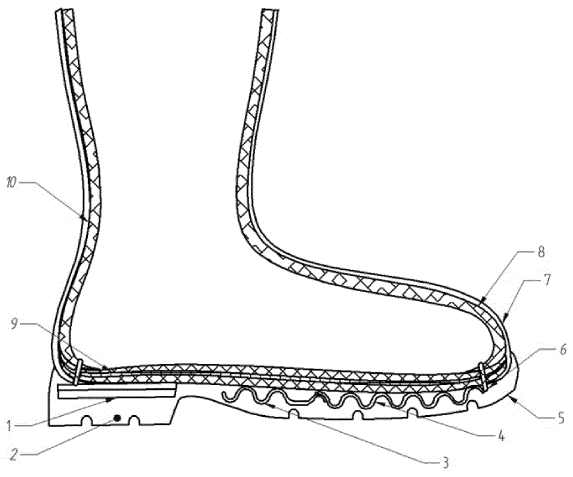
(54) BOOT FOR PROTECTION AGAINST "SHOCK WAVE" ANTI-PERSONNEL MINES

(57) The "Boot for protection against "shock wave" anti-personnel mines" comprises a simple and robust generic body-shield system for preventing injuries caused when an anti-personnel mine is triggered, said system being integrated into a boot. The system comprises a shield with threefold protection: a sole for absorbing pressure and thermal energy; a deflector for dissipating thermal energy in so far as it is broken down and reflects pressure, a main shield for containing the pressure shock wave and a secondary shield for providing protection from fragments, which together dissipate the shock wave, and provide protection from high temperatures and from the fragments generated during the explosion of the artefact. The land conditions for which the invention has been developed, lightweightness, size and flexibility to facilitate use, and lower costs and triple protection (fragments, shock wave and high temperature) are aspects taken into account and incorporated in this invention.

FIGURE 1



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Description

FIELD OF THE INVENTION

[0001] The invention is related to boot type footwear for civilian and military use, aimed to protect people against blast effects from non industrial or improvised antipersonnel land mines, preventing the user from injuries that would be present without the use of the boots or reducing the injuries caused by the explosive device. The present solution brings protection in the case of non industrial or improvised antipersonnel land mines. An armor system for antipersonnel land mines integrated to the boot is presented. The armor system has three protection elements, a sole for thermal and blast energy, a deflector for thermal and blast energy dissipation while disintegrated and a main armor to stop the remaining blast wave pressure. The boot also has side armor to protect against shrapnel.

BACKGROUND OF THE INVENTION

[0002] Traditionally, land mine protection has been achieved using boot types or other protection devices that sometimes are able to reduce injuries from antipersonnel land mines activation, but they are not able to protect against the three different phenomena or consequences derived from land mine activation, or are able to protect against the three phenomena but price is making it unaffordable for general use or for long distance walking if a high level of mobility is required.

[0003] Other approaches to solving the problem are:

> A military boot type sole is assembled using a honeycomb core. The protective mechanism increases foot distance to the ground. The problem with this invention is that when part of the sole geometry is joined with the honeycomb it can create shape charges increasing the blast effect.

[0004] Sole reinforcements have also been used by adding semi elliptical woven sections which are integrated to the sole and reinforced with metallic webs and girders which give resistance against penetration but do not give protection against thermal gradient caused by the explosion.

[0005] Another invention has used a sole with an industrial safety use insole with injected plastic and metallic reinforcement to give protection against penetrations. This device brings protections against penetrations but does not give protection against blast wave.

[0006] Other approaches attach a box type device to the wearer foot with regular shoes; the box is made with acoustical absorbing materials. The device is layered with a thermal resistant material, a layer of water proof material and a layer of penetration resistant material. The device is designed to avoid mutilations from land mine activation but present the problem that it is not designed for mountain terrains and does not fit naturally to the wearer foot.

[0007] An approach using a blast and sharpnel resistant boot made with a rubber sole with a *Kevlar 49* layered insole is integrated to the sole. A *Kevlar 49* shell is used under the body of the boot which is later sewed to the boot. Boot inside armor is joined to the boot body shell with adhesives. It has the problem that the armor is disintegrated when the antipersonnel land mine has a high explosive velocity and these explosives have a higher thermal gradient.

[0008] Antipersonnel land mine protective insole has also been use; the insole is made by at least 30 layers of high resistance woven material. The insole is manufactured with a first layer of high resistance material followed by a layer with equal or less resistance. In the first layer, woven Kevlar is used and in the second Spectra is used. The layers are sewn to the perimeter and inside the insole forming a grid. The system has the problem that the armor is disintegrated when the antipersonnel land mine has a high explosive velocity and these explosives have a higher thermal gradient.

[0009] Another approach consists of antipersonnel land mines protective system built with an accessory assembly to the foot of the wearer with regular shoes; it has 4 legs that elevate a platform from the ground, the platform has a V shape in the downside that deflects the shock wave to the sides. It has the problem that it is not designed as a regular shoe and does not adapt naturally to the foot, causing fatigue and limiting wearer mobility.

[0010] A protective boot and sole configuration has also been developed. The boot sole consists of a corrugated resistant material sheet and a rubber sole. The corrugated structure is manufactured from metal or metal matrix ceramic composite placed in the foot ball, in the foot front or from the foot ball to the foot front. Recovering the foot, specifically between the outer boot shell and the foot, there is an armor consisting of two or three layers of *Twaron;* the layers are adhered using hot melt polyurethane adhesives. Between the armor material shell and corrugated structure there an insole composed by at least 15 layers of woven aramid and woven ceramics in the down side. This has the problem that the corrugated sheet is made from metallic and ceramic material generating shrapnel after the explosion.

[0011] Another approach to solving the problem is a fragment and shock wave resistant safety boot sole based on a polyurethane and polyester sole with woven aramid reinforcements integrated to the sole; these materials are wet with polyester or polyester polyurethane to enhance the adherence between the reinforcement and sole material adhesion and carbon and glass fibers could be integrated to the reinforcement to enhance thermal resistance. It has the problem that the reinforcement adhesives increase the compatibility but cannot be placed in the right amount to achieve the protection level needed for the non industrial improvised antipersonnel land mines.

[0012] Land mine protection devices consisting of a V shape sole (Boat hull shape) have also been used with a 40 to 80 Shore A hardness. Sole geometry reflects land mine blast wave but it has the problem that the V shape has high inertia limiting user mobility and also the V shape sole does not mitigate the thermal energy generated by the high explosive velocity as found in personnel land mines.

[0013] Finally, footwear type composed by an inside sole inclined sheet to reflect shock waves and an over sole boot protection made with polycarbonate has been used; on this device the inclined sheet can be metallic and be provided with explosive material to equilibrate land mine explosive energy underneath it. It has the problem that the inclined sheet material could become shrapnel, causing injuries to the user.

[0014] Based on the alternatives reviewed for solving the existing problem, in general, the two approaches to achieving antipersonnel land mines protection are:

- Devices attached to the footwear do not offer a solution in cases of abrupt mountainous terrains and where the presence of antipersonnel land mines is constant. Attachable devices cause user fatigue and limit mobility.

- Armor footwear type as explained is also insufficient, because it does not offer a solution where higher thermal gradients or shock waves are present. It has been seen that these two effects can be joined in non-industrial improvised antipersonnel land mines.

[0015] The cited alternatives were analyzed on Equatorial Andean terrains with higher antipersonnel land mines injuries. It was found that due to the limiting mobility over transport vehicles, the solution to the problem should be comfortable armor footwear type, having proper protection level according to the non-industrial improvised antipersonnel land mines presented on these fields that are loaded on average six times higher than industrial or military standard land mines and the explosive type varies from the region where the mine is built. Due to the fact that explosive power and explosion temperature of antipersonnel land mines found on the territory cited above, large controlled testing has been carried out and concluded that that these inventions fail with explosions which are highly loaded and with a higher thermal gradient.

[0016] The invention **"Blast wave type antipersonnel land mine protection boot",** are regular infantry boots which provide protection against antipersonnel land mine effects, which reduce injuries and related effects caused by these type of devices on the lower limbs. The boots use body armor in order to deflect shock waves and provide proper protection against non-industrial antipersonnel land mines like the ones present on the Colombian territory and prevent injuries from shock waves and higher temperatures that cause severe injuries to the victims, or simply disintegrate the armor leaving lower limbs exposed to shock wave effects. They are also effective against shrapnel generated by the explosion, are comfortable to use even in abrupt mountainous terrains and do not produce excessive fatigue even after long walks, and offer an affordable price.

[0017] The **"Mine Pro Blast Wave Type Antipersonnel Land Mine Protection Boot"** relevance consists in that it solves the problems found with the previously cited inventions. Given the nature of non-industrial antipersonnel land mines, with this invention, protection is achieved with high explosive loads and higher thermal effect than for standard military land mines.

SUMMARY OF THE INVENTION

[0018] **The Footwear for protection against land mines of shock wave type,** is an armor plating system for protection against anti-personal mines integrated into a countermine boot. The system is made up of armor with three elements of protection, a sole to absorb thermal and pressure energy, a deflector to dissipate thermal energy to the extent that it breaks down and reflects pressure, a main armor to contain the shock wave of pressure and a secondary armor to protect from fragments.

[0019] The purpose of the **Footwear for protection against land mines of shock wave type** is to provide a generic body armor system simple and robust to prevent injuries caused when operating anti-personal handcrafted mines used by insurgent forces. The system is a combat boot with built-armor that dispels the shock wave from the explosion. The armor incorporates an energy dissipating sole, a wave deflector with dissipating wave channels, a basis of thermo-stable resins and high mechanical strength fibers and a lead armor built using a multilayer system of high mechanical strength material, which together dissipate shock and protect from the fragments generated during the explosion of the bomb. The invention supports and protects from the effect of the shock wave, decreasing or even preventing lower limb injuries and avoiding mayhem in individuals belonging to military forces, peasants and civilians that due to the nature of their work must move in areas under the influence of land mines.

[0020] The invention is classified as a device for body armor that protects users from injuries caused by landmines. It decreases specifically the rate of mutilation caused when the user activates, by pressure or pressure relief, a landmine.

[0021] The effect of the shock wave destroys the various components of the armor but as the armor is reduced, the energy is dissipated and the effect of heat and pressure generated by the land mine is finally dispelled.

[0022] To achieve the appropriate level of protection, an increase in the thickness of each of the components of the armor should be achieved until attaining the required protection for a given mine. According to the

above, several options of protection against injuries caused by antipersonnel mines have been established.

[0023] Land conditions for which the invention has been developed, lightness, size and flexibility for ease of use, as well as lower costs, have been items taken into account and incorporated herein.

DETAILED DESCRIPTION OF THE INVENTION

[0024] The presented invention **"Blast wave antipersonnel land mine protection boot"** consists of a four element armor system integrated to a boot in order to offer protection against non industrial improvised antipersonnel land mines and standard military land mines, generating blast waves, shrapnel and high temperatures which was developed by the need of military personnel and specifically infantry troops to have protections systems against antipersonnel land mines found on operational theaters. The solution presented is not just for military and police use, it is also practical for farmers, journalists and the civilian population who given the nature of their jobs need to mobilize in areas where presence of antipersonnel land mines is suspected.

[0025] A body armor device integrated to footwear protects the user against injuries and mutilations caused by buried antipersonnel land mines. The cited device on this document is an armor boot against buried antipersonnel land mines consisting of an energy mitigation sole (A2), a wave deflector with wave deflection channels (A1), main armor (A9) and a boot body over the armor with secondary armor (A10-A8). Boot sole and deflector protect against high temperatures and blast wave; the main armor protects against shrapnel and also mitigates the blast wave; the secondary armor also protects against shrapnel. In this manner, the invention protects against the three effects derived from the explosion of a non industrial or military standard antipersonnel land mine.

[0026] The field conditions of this development such as lightness, size and flexibility to ease usability as well as low manufacturing costs have been key factors taken into account. These enhancements have been achieved by three armor stages consisting of a rigid sole manufactured on high temperature resistance rubber, a blast wave deflector manufactured with *epoxy novolak vinyl ester, epoxy bisphenol A vinylester, E glass fibers and carbon fibers ,* a main armor manufactured with fiber *polyaramid* reinforced *polycloroprene;* protection against two antipersonnel land mines (industrial standard and improvised), protecting against blast wave, shrapnel and high temperatures and solution of key factors such as mobility, comfort and lower comparable cost.

[0027] The boot has vulcanized elastomers (A2) on the energy mitigation sole, which is disintegrated with the improvised antipersonnel land mine blast wave and the heat generated. The sole itself, integrates a blast wave deflector manufactured with fiber reinforced plastic with a semicircular channel geometry (figures 1.1 - 1.3), which drives the antipersonnel land mine shock wave energy. In addition a main armor insole is incorporated (figure 1.9) assembled to the shoe upper body and manufactured with woven polymer fabrics joined with adhesives. Also, the land mine antipersonnel protection boot has a inner upper body shoe shell (figure 1.10 - 1.8), consisting of woven polymer fabrics sewn on the edges and adhered to the shoe with polymer adhesives.

[0028] The energy mitigation sole is mechanically assembled to the shoe by contact cements or by direct injection and vulcanizing.

[0029] The blast wave deflector mechanism consists of semicircular channels (figure 1.1 - 1.3 - 1.4) placed lengthwise and crosswise under the heel and the foot front. It is joined with adhesives to the main armor sewn to the upper shoe.

[0030] To ensure boot protection against improvised antipersonnel land mines effectiveness, high thermal resistance is needed. The thermal resistance is achieved with the combined effect from the rubber sole and the blast wave deflector.

[0031] The blast wave deflector is a channel with semicircular geometry which is integrated to the sole of the heel section, in the mid foot and in the forefoot.

[0032] The deflector is manufactured by:

1) Vacuum assisted resin infusion *(VA-Infussion).*
2) Resin transfer molding *(RTM).*
3) Resin transfer molding light *(RTM Light),* or autoclave molding.

[0033] The manufacturing process of the deflector (Figure 4) or mold, is performed in two stages: First (Figure 3.1) is made with *Chopped Strand Matt* of Fiberglass E, 600 g/m^2, with flat-woven non-twisted fiberglass yarn 320 gr/m^2. This first stage is performed with *novalac epoxy vinyl ester resin* with a resin-reinforcement ratio of 0.4. This first stage has a silicone countermould, variations of this invention include plastic films. The use of rigid or semi-rigid countermoulds can leave residues of form release agents at the interphase between the first and the second stage thus reducing the Young modulus of the deflector, to the extent that there is slippage between the two stages.

[0034] The second stage of the deflector (Figure 3.2) is performed with a second countermould. Lamination consists of flat-woven tissue of not twisted yarn of high modulus carbon, alternated with non-woven sheets of *Chopped Strand Mat,* 220 g/m^2, which are made of 5 layers of nonwoven E-glass sheets and flat-woven of non-twisted carbon yarn. The infusion is made with *bisphenol A vinyl ester epoxy resin;* variations of the invention include epoxy infusion with no nonwoven E-glass sheets. If the variation is applied with epoxy resin the number of layers in the first stage should be increased because non-woven E-glass sheets increase the resistance against high temperature, while carbon content increases mechanical resistance against wave pressure shock. In all cases after curing of deflector should be

done to increase glass transition temperature of the compound.

[0035] Variations of the invention where higher level of protection is required can be made by increasing the number of layers without these losing their protection characteristics, mobility and cost and making different combinations of several flat-woven, unidirectional fabrics and other types of non-twisted fibers such as *poly p-fenilen tereftalamid (aramid),* boron fibers, S-glass and basalt fibers.

[0036] In controlled tests with mines loaded with high explosive detonation velocity, 7000 m/s, it has been found that the efficiency of the deflector increases when the two stages are contained. It has also been found that material made of reinforced plastic and composite ceramic fiber is suitable for application as *bisphenol A epoxy resin vinyl ester* breaks down with high temperature, as well as non-woven sheet models of E-glass fiber. During these calcinations thermal energy released by the explosive that has already broken the sole, breaks down the deflector. This has two effects, thermal energy is dissipated before reaching the main shield and it routes part of the shock wave outside of the boot, thus protecting the user from high temperatures and reducing the effect of the shock wave pressure.

[0037] On the shock wave deflector is the body of the boot which includes the secondary armor (Figure 1.8) against fragments and main armor, the toecap, the buttress, the bellows and the reed. This has lead shielding in the area of the trim

[0038] The reed and the buttress are armored with layers of 200 g/m^2, alternating with layers of 450 g/m^2 of flat-woven of not twisted fibers of aromatic *poly* p-*fenilen tereftalamid,* these layers are bonded with polychloroprene contact cement. The inventor has found that laminates made with *poly* p-*fenilen tereftalamid* and polychloroprene increase ballistic resistance as ballistic particles have to tear the adhesive between the layers of reinforcing material to increase the absorption of energy in the armor system. The armor consists of one or more alternating layers of non-twisted yarn of flat-woven *poly* p-*feline tereftalamid,* 200 g/m^2 and 450 g/m^2, laminated with *polychloroprene* contact cements.

[0039] The secondary shield is sewn to the area of the template to the main shield with nylon threads. The main shield is composed of layers of flat-woven yarns of not twisted *poly* p-*feline tereftalamid,* 200 gr/m^2 and 232 gr/m^2, laminated with contact cement of *polychloroprene.* The inventor has found 14 layers of 200 gr/m^2 and 2 layers of 232 gr/m^2, important and appropriate levels of protection. Use of 2 layers of non-woven sheets of fiberglass-E 600 g/ m^2 provides a final thermal barrier. These are sewn against the rolled deflector of *poly p-fenilen tereftalamid* bonded with *polychloroprene.* Future variations of the invention include a greater number of layers and the use of flat-woven not twisted yarns of polyethylene of ultra high molecular weight and other types of weaves, without altering the characteristics of cost and convenience.

[0040] The main armor is sewn into the bottom of its perimeter with leather section of the toecap and the reed of the boot that has no side armor. Sewing is made with threads of nylon.

[0041] The body of the boot with side armor and the main armor is positioned in a vulcanizing press. Inside the press the deflector of the shock wave is located. Melt rubber is then added and the deflector is embedded between the sole.

BRIEF DESCRIPTION OF THE DRAWINGS

[0042]

FIGURE 1:
Figure shows the longitudinal section of the boot with the armor system.

Figure 2:
Figure in which there is a cross section of the heel.

Figure 3:
Layout outline of the two stages corrugated deflector.

Figure 4:
Layout outline of the main armor.

Claims

1. The **Footwear for protection against land mines of shock wave type,** is **characterized by** being composed of an outer body with secondary armor (Figure 1.7) attached to the inside of the leather toecap of the boot (Figures 1.8 - 1.10), consisting of several layers of *poly p-fenilen tereftalamid* bonded with *polychloroprene* to the interior of the leather toecap, a boot of conventional exterior design with a sole (Figure 1.2) having a rigid deflector embedded in the heel (Figure 1.1), several deflectors of articulated rigid armor plating on the ground (Figure 1.3 - 1.4) and lead and an armor plating in the sole (Figure 1.9).

2. The **Footwear for protection against land mines of shock wave type,** according to claim 1, has the main armor plating (Figure 1.9) consisting of alternating layers of flat-woven of *poly* p-*fenilen tereftalamide* stuck together with polychloroprene adhesives.

3. The **Footwear for protection against land mines of shock wave type,** according to claim 1, the outer body of the boot (Figure 1.7) consists of a leather cover or polymeric textile fabrics; within this there is an insulation of nonwoven sheets of ceramic materials, flat-woven yarns of ceramic materials bonded

to the outer shell with *polychloroprene* adhesives and multiple layers of flat-woven yarns of *poly* p-*feline tereftalamide* configuring the secondary armor system (Figure 1.8).

4. The **Footwear for protection against land mines of shock wave type,** according to claim 1, has in the sole a rigid armor embedded on the heel which consists of a composite material of nonwoven sheet reinforcements and ceramic flat-woven fabrics, in a thermo-stable resin matrix that makes up the heel deflector (Figure 1.1).

5. The **Footwear for protection against land mines of shock wave type,** according to claim 1, the sole has a wave deflector or rigid armor embedded in the back of the foot, consisting of several thin rigid plates made of reinforcement material of non-woven sheets and ceramic flat-woven fabric in a matrix of thermo-stable resin. These plates are hinged to allow movement of the sole that make up the deflector-plant (Figure 1.3 - 1.4).

6. The **Footwear for protection against land mines of shock wave type,** according to claim 2,, has a cover in the outer body of the boot to which a thermal insulation attaches, consisting of one or more layers of nonwoven sheets or ceramic fibers or one or several layers of woven ceramic fibers or combinations of flat-woven fabrics and nonwoven sheets. These layers are bonded to the outer sheath with *polychloroprene* adhesive (Figure 1.10).

7. The **Footwear for protection against land mines of shock wave type,** according to claim 2, has a ceramic fiber insulation in the outer body of the boot which adheres to the secondary or side armor and consists of one or more layers of flat-woven *poly* p-*feline tereftalamide* fibers (Figure 2.8).

8. The **Footwear for protection against land mines of shock wave type,** according to claim 3, has an embedded rigid armor in the heel section of the sole (Fig. 1.1), consisting of 2 arrays of thermo-stable resins (Figure 3.1a - 3.1b). The first material is a composite of nonwoven sheets of ceramic fibers with a matrix of *epoxy novalac vinyl ester resin* or *epoxy novella resin.* The second material is a composite of non-woven sheets of ceramic fibers with ceramic flat-woven fabric in a matrix of *epoxy bisfenol A vinyl ester resin* or *epoxy bisphenol.*

9. The **Footwear for protection against land mines of shock wave type,** according to claim 4, has a rigid armor embedded in the rear section of the sole composed of several articulated plates (Figure 1.3 - 1.4), made of a material consisting of 2 arrays of thermo-stable resins. The first material is a composite of nonwoven sheets of ceramic fibers with a matrix of epoxy novalac vinyl ester or epoxy novalac. The second material is a composite of nonwoven sheets of ceramic flat-woven fibers in matrix of *epoxy bisphenol A vinyl ester resin* or *epoxy bisphenol.*

10. The **Footwear for protection against land mines of shock wave type,** according to claim 7, alternates layers of flat-woven *poly* p-*feline tereftalamide* with *polychloroprene* adhesive. These layers are alternated with one or more layers of flat-woven fabrics of *poly* p-*feline tereftalamide* with *polychloroprene* adhesive. *Poly* p-*fenilen tereftalamide* fabrics should be 123 g/m^2 or more.

11. The **Footwear for protection against land mines of shock wave type,** according to claim 8, has a rigid armor in the sole composed of two materials. The first material is a thermo-stable plastic matrix reinforced with ceramic fibers made up of *epoxy novalac vinyl ester resin* or *epoxy novalac resin* reinforced with glass ceramic fibers, carbon, basalt or boron. Fibers are nonwoven sheets of short fibers, less than 10 cm, of non-twisted yarns or flat-woven fabrics. The second material is a compound of *epoxy bisphenol A vinyl ester resin* or *expoxynolac vinyl ester* reinforced with nonwoven sheets of glass fibers and flat-woven made of ceramic fibers. Flat-woven ceramic fibers are glass fibers, carbon fibers, basalt fibers or boron fibers. Nonwoven sheets of ceramic fibers have a surface mass of 150 g/m^2 or more, flat-woven ceramic fibers have a surface mass of 123 g/m^2 or more. These two composite materials are superimposed the first on the second.

12. The **Footwear for protection against land mines of shock wave type,** according to claim 8, has a corrugated cross section in the rigid armor or shock wave deflector located in the heel and consists of two polymeric materials reinforced with ceramic fibers, situated in the directon in which the channels are parallel to the greater length of the foot (Figure 2).

13. The **Footwear for protection against land mines of shock wave type,** according to claim 8, has a corrugated cross section in the rigid armor or shock wave deflector located in the heel and consists of two polymeric materials reinforced with ceramic fibers, situated in the directon in which the channels are perpendicular to the longer length of the foot (Figure 1.3 - 1.4). These channels overlap in one or more points to give flexibility to the sole.

FIGURE 1

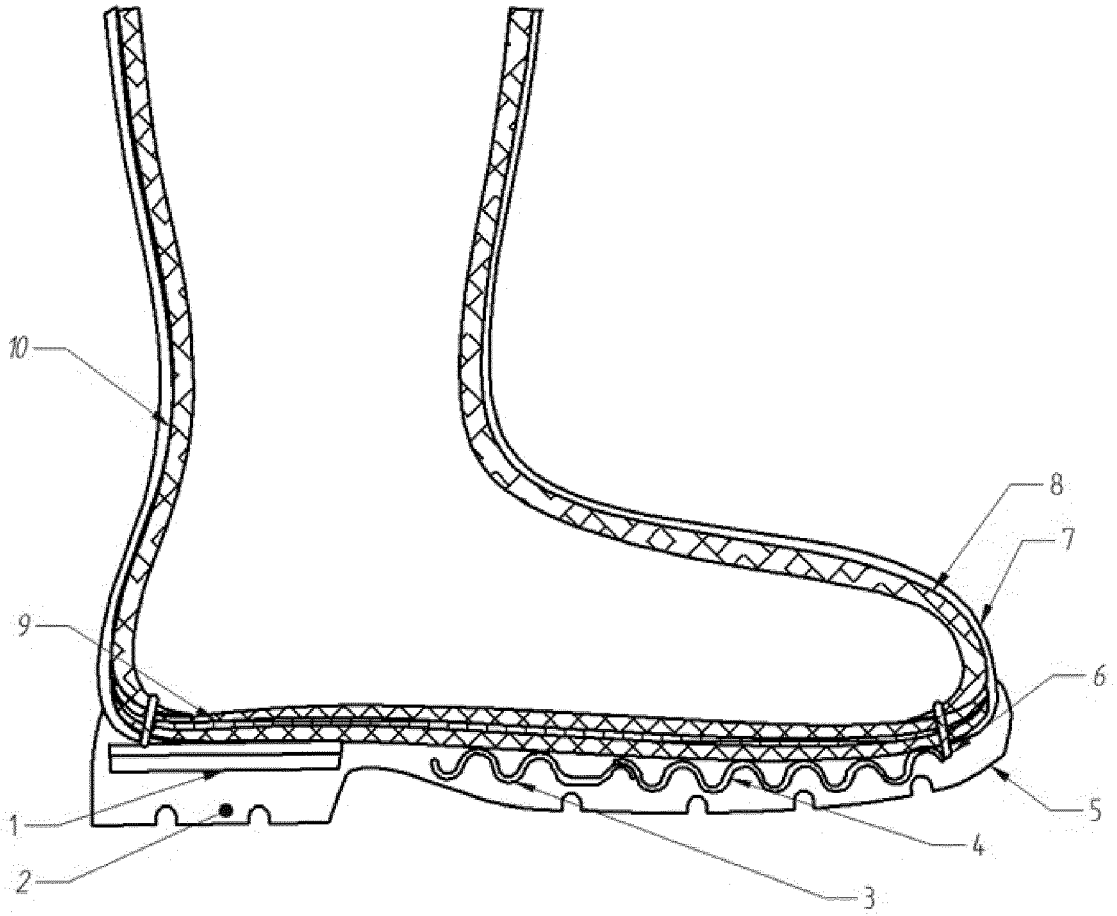


FIGURE 2

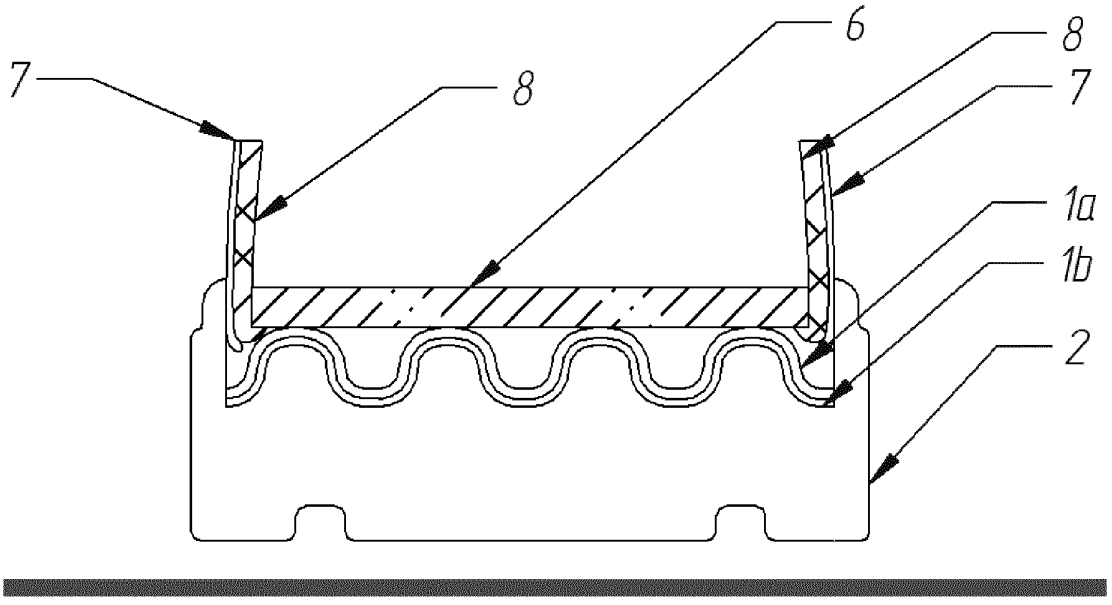


FIGURE 3

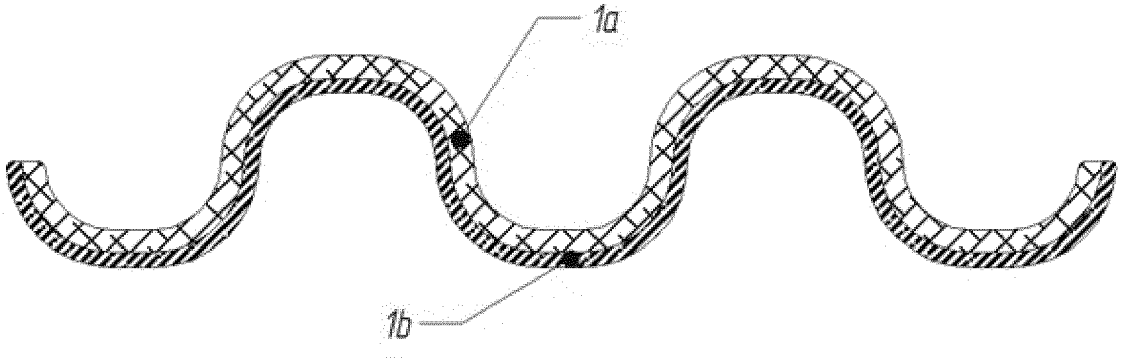
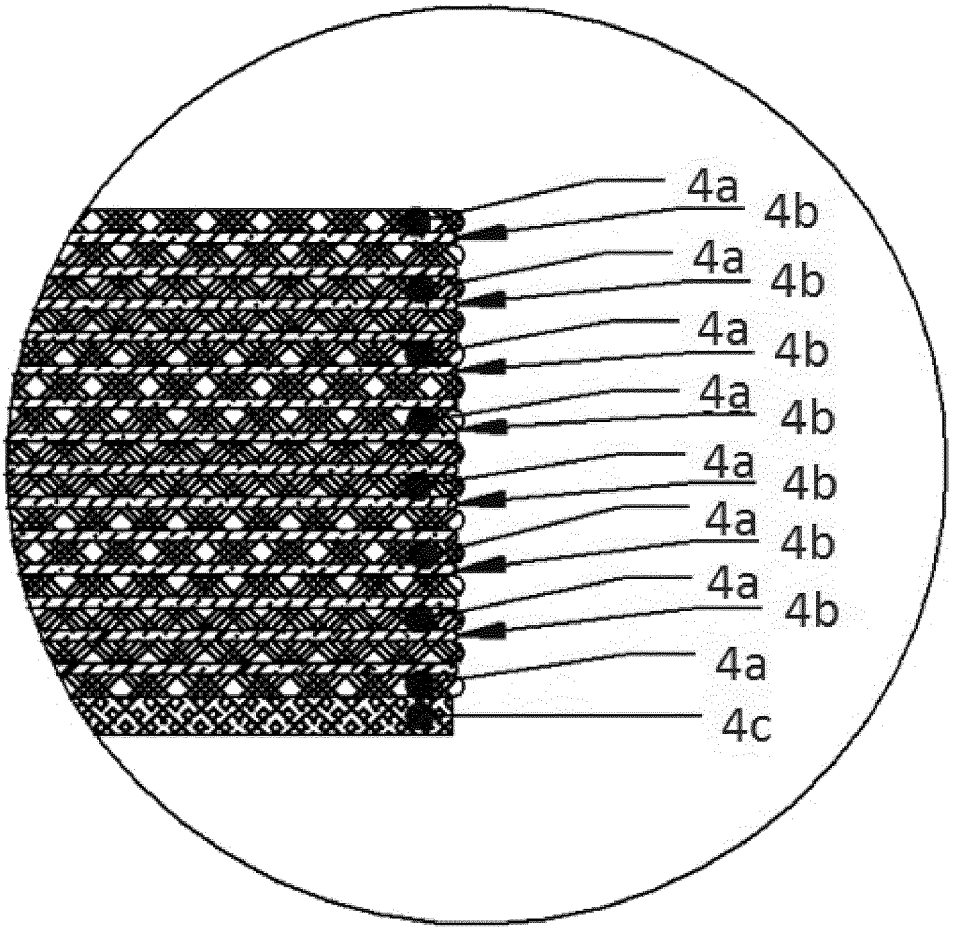


FIGURE 4



INTERNATIONAL SEARCH REPORT

International application No.
PCT/ IB 2009/005619

A. CLASSIFICATION OF SUBJECT MATTER

see extra sheet
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,F41H

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)

INVENES,EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6461673 B1 (VAZ et al.) 08.10.2002, description; figures 1,3	1-13
Y	FR 2573969 A1 (QUINETTE INTERNAL SA) 06.06.1986, abstract; page 2, line 5-8;	1-13
A	WO 9743919 A1 (VAZ GUY ANDREW) 27.11.1997, the whole document.	1-13

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

* 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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 May 2010 (24.05.2010)	**(25/05/2010)**
Name and mailing address of the ISA/ O.E.P.M. Paseo de la Castellana, 75 28071 Madrid, España. Facsimile No. 34 91 3495304	Authorized officer Y. Muñoz Arcones Telephone No. +34 91 349 30 80

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

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/ IB 2009/005619

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