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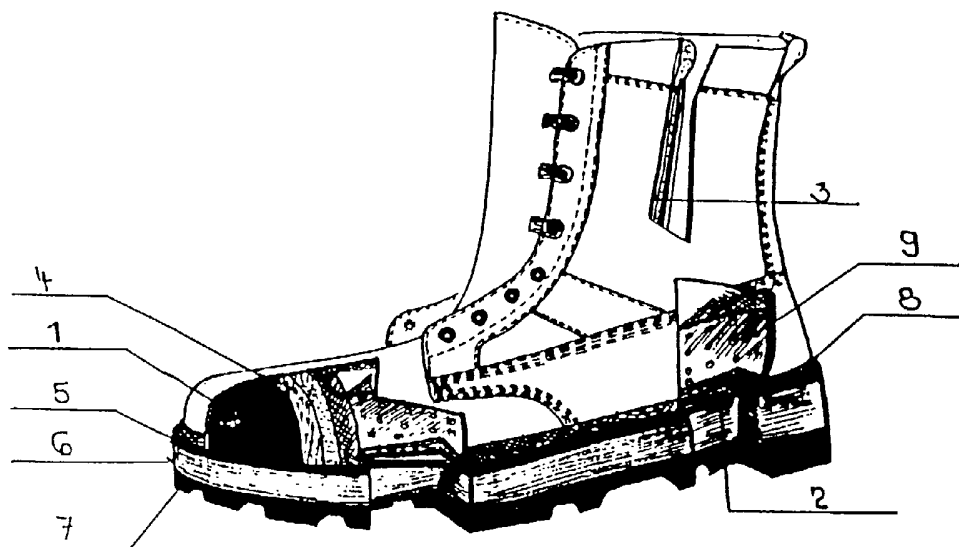
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(54) Title: ANTI LAND-MINE BOOTS



(57) Abstract: The anti land-mine boot comprises an upper with a lasting insole and a half-sole attached to the upper by means of a system of at least two middle soles. The lasting insole (2) and/or at least one of the middle soles (5, 6) are made from a composite comprising at least three layers of para-aramide fabric fixed in a polymer matrix and the boot upper (3) incorporates at least one layer of the reinforcing para-aramide fabric (4) between lining and the upper material, the lining with these interlayers being covered by at least three layers of para-aramide fabric in the walking part of the boot. Edge parts (8) of the said three layers of the para-aramide fabric divided about their circumference are turned up and oriented in such a way that the circumferential joints of the turned up edge parts are mutually shifted and overlapped in separate layers. In boot tip, heel and/or insole regions protective segments (1) of a composite comprising at least one layer of para-aramide fabric fixed in polymer matrix are built into the boot structure.



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Anti land-mine boots

Field of invention

The invention relates to special protective boots protecting human body, particularly its lower limbs, from effects of land mine explosion.

Description of the prior art

The anti-personnel land mines belong among weapons of mass destruction, which - by their efficiency - do not lag behind nuclear, chemical and biological weapons. With respect to their character the mines are known to act primarily against civilian population and frequently even long after the armed conflict is over. It is estimated that at present about one hundred million land mines lie hidden under the soil, i.e. approximately one mine per every fifty people on the Earth. In addition, the land mines are frequently developed not to directly kill but to cause painful injuries with lasting consequences.

With respect to the above facts it is understandable that an effort is made to develop special anti land-mine boots capable of providing a man exposed to hazards of land mines with the maximum protection against their effect. Historically, the oldest protective mean of this kind are multi-chamber protective cushions which are fixed under the common footwear by means of a frame with a binding. The separate chambers interconnected along the cushion sides are made from a rubber inner-tube and an outer material resistant to abrasion and cutting. Further, the cushion is provided with straps, having for instance Velcro type fasteners, for attachment of the frame to the binding. True, the protection cushions protect relatively well from the effects of land mines but considerably hamper movement during wearing of the boots, which is unacceptable, particularly in military combat conditions.

A similar difficulty, though not of such a great extent, is encountered in case of the other invention - a protective platform comprising a special shock deflector - a deflecting prism placed in a profiled sole made of polyurethane foam. The walking surface of the platform is provided with an anti-skid layer. Further, a binding in the form of a shell, reaching above the wearer's ankle, is attached to the platform. The shell provides a support during walking and protects the wearer from mine fragments (splinters). Common boots are fixed in the binding by means of belts. The shock deflector is located along the entire foot length and width. It is of a conical shape with apical angle less than 90 ° and is placed in such a way that its vertex is directed toward the walking side of the platform. In this manner the surface on which explosion of the land mine is acting is increased on the one hand and the conical shape of the deflector walls directs mine fragments in the desirable direction on the other. With respect to its construction the deflector can be either solid or hollow, made of metal or from plastics composites. In the preferred embodiment a tubular plastics composite wrapped with a fabric is used.

As already said, the above invention incorporating a protective platform falls into the area of special protective equipment which protects well the human body from effects of a land mine explosion but, on the other hand, hampers fairly much natural movement during walking, particularly in running, jumping, etc.

Therefore, there are increasing attempts to develop anti land-mine boots which would, on one hand, protect the wearer from effects of mine explosion and, on the other, differ in their

design from common footwear as little as possible. In this respect, for instance, protective boots are known at present, in the middle sole or sole of which at least one protective layer is placed, the protective layer comprising at least ten layers of para-aramide (most frequently Kevlar) fabric placed on each other. This construction allows a very good protection from effects of land mine explosion thanks to the sole or middle sole itself but fails to afford mine blast resistance as a whole.

Even anti land-mine boots, so far of the best design, have a similar shortcoming. Similarly as the previous types of anti land-mine boots the boots are composed of an upper with a lasting insole and a sole attached thereto directly or by means of a middle sole. The nature of the invention consists in the fact that the lasting insole and/or the middle sole are made as a compact semi-finished product from a flat composite material comprising at least six layers of para-aramide fabric fixed in the polymer matrix. Simultaneously, a shock attenuating element of a conical shape is placed in the boot sole structure with the vertex of the above element directed to the walking side of the sole. The shock attenuating element comprises a hollow armour of an appropriate shape and an internal filling of a honeycomb structure.

Nature of the invention

The above shortcomings are eliminated to a great extent by a new type of anti land-mine boots according to this invention. The boot includes an upper with a lasting insole and a half sole attached thereto by a system of at least two middle soles. The nature of the invention consists in the arrangement where the lasting insole and/or at least one of the middle soles are formed by a composite comprising at least three layers of para-aramide fabric fixed in a polymer matrix and the upper has at least one layer of a para-aramide reinforcing fabric between the lining and the upper material. In the walking part of the boot the lining incorporating these interlayers is covered by at least three layers of the para-aramide fabric, the edge parts of which, divided about their circumference, are turned up and oriented in such a way that circumferential joints of the turned up edge parts are mutually shifted and overlapped in separate layers. In the boot tip, heel and/or inner sole region protective segments from a composite comprising at least one layer of para-aramide fabric fixed in polymer matrix are incorporated in the boot structure. The bottom part of the boot contains a system of middle soles and a half sole attached thereto, with at least one of the middle soles of the upper part of the system being made from a composite material and at least one of the middle soles of the lower part of the system being made from a polymer foam.

Advantageously, at least one layer of the para-aramide fabric is fixed in the half sole structure.

The anti land-mine boot is further completed with a sock lining, advantageously from a composite material comprising at least one layer of the para-aramide fabric fixed in polymer matrix, the sock lining having air cells.

Advantageously, the para-aramide fabric used in separate boot components is a Kevlar fabric. The polymer matrix can be an elastomer compound, primarily rubber or polyurethane or thermoplastic, particularly ethylene vinyl acetate copolymer.

The middle sole of the upper part of the middle sole system incorporates a groove system on the side adjacent to the lower part middle sole and is made from a composite material containing para-aramide fabric.

Advantageously, the middle sole of the lower part of the middle sole system is made of a polymer foam material, specifically of an elastomer foam or a polyolefin foam material.

The main contribution of the new design of the anti land-mine boot consists in an optimum balance of requirements for protective efficiency, mass and flexibility of the boots during walking, running and/or jumping as well as durability in wearing. The optimum performance is achieved by combining protective effects of the rubber segment with the para-aramide fabric and the para-aramide fabric as such. In this boot design the boot upper retains its breathing properties. The entire protective segment of the boot forms a compact whole comprising composite material, the para-aramide fabric layers of which are fixed and interconnected in the polymer matrix without any foreign body. The boot does not contain any metal bodies.

In the heel part of the boot sole the walking part is provided with little wholes (channels) for deflection of the pressure energy during mine explosion.

Another contribution of the invention is a combination of materials of various density causing deflection of the pressure wave during explosion and blast energy consumption when separate boot layers are gradually tearing away.

Brief description of the drawings

The nature of the invention will now be described in a greater detail by way of the enclosed drawings in which Figure 1 is a detail of the lasting insole and of para-aramide fabric layers with divided edge parts turned up, Figure 2 is a detail of the middle sole of the upper part of the middle sole system, Figure 3 is a detail of the middle sole of the lower part of the middle sole system, Figure 4 is a detail of the half sole, Figure 5 is a detail of the sock lining, Figure 6 is a detail of the protective segments and Figure 7 is an overall view of the anti land-mine boot.

Description of the preferred embodiments

The anti land-mine boot in the preferred embodiment (see the boot overall view in Figure 7) comprises an upper 3 with a lasting insole 2 and a half sole 7 attached to the upper 3 by means of a two middle sole system.

The lasting sole 2 (see Figure 1) is made from a composite containing three layers of Kevlar textile (fabric) fixed in a polymer matrix formed by an elastomer compound.

The upper 3 (see Figure 7) is of a knee-high Derby boot type with a cow hide or softened pig skin leather upper material, a padded cuff and padded leg part and with grommets or eyelets for fast boot lacing. There are two layers of a reinforcing Kevlar fabric 4 between lining and the upper material of the upper.

In the walking part of the boot the lining with these interlayers is covered with seven layers of para-aramide fabric, the edge parts 8 of which, divided about their circumference, are turned up and oriented in such a way that circumferential joints of the turned up edge parts are mutually shifted and overlapped in separate layers (see Figure 1).

In the boot tip and heel regions shaped protective segments 1 (see Figure 6) are incorporated in the boot structure, the said protective segments being made from Kevlar fabric fixed in polymer matrix based on natural rubber compound.

The bottom part of the boot comprises a system of middle soles 5, 6 and a half sole 7 attached thereto. The middle sole 5 of the upper part of the middle sole system (see Figure 2) is made from a composite material containing four layers of Kevlar fabric in elastomer matrix and on the side adjacent to middle sole 6 of the lower part of the middle sole system has a milled out system of venting grooves for drawing off air in the event the land mine explodes. The middle sole 6 of the lower part of the system (see Figure 3) is made from a foam porous polyolefin material. The half sole 7 (see Figure 4) is made of a wear resistant rubber compound and comprises a reinforcing Kevlar fabric fixed to the said rubber compound and milled out grooves.

The anti land-mine boot is completed with a sock lining 9 (see Figure 5) from a rubber compound incorporating Kevlar fabric vulcanised into the said rubber compound, and air cells.

In manufacture of the anti land-mine boots according to the present invention (see Figure 7) the needed semi-finished products are prepared in advance. Using a vibrating knife separate layers of the lasting insole 2, middle sole 5 of the upper part of the system, upper 3 and rubber protective segments 1 reinforcement are cut out from the Kevlar fabric. The layers of the Kevlar fabric are fixed into the lasting insole 2, middle sole 5 of the upper part of the system and the protective segments 1 and interconnected in the polymer matrix, which is a reaction product of the rubber compound comprising natural, polybutadiene and styrene butadiene rubbers and sulphur vulcanisation system and a combination of carbon black/calcium carbonate fillers. During stitching of the upper 3 an upper reinforcement comprising Kevlar fabric layers is stuck between the boot lining and the upper material.

When assembling the anti land-mine boot according to the invention the lasting insole 2 is attached temporarily with a sticker or a staple onto the last. Subsequently, lining with the Kevlar reinforcement is lasted in the order tip, side and heel. Using a polyester and polyamide based thermoplastic adhesive the lasting allowance of the boot lining is joined with the lasting insole 2 and the metal staple is removed from the lasting insole 2. Then separate layers of the reinforcing textile 4 (specifically Kevlar fabric) are stuck onto the lasted lining comprising the Kevlar reinforcement in such a way that all transitions are mutually lapped over. Rubber adhesive is employed to stick the layers. Subsequently, protective segments 1 with the fixed Kevlar fabric are stuck over the segment created in this way in the boot tip and heel. Again, rubber glue is used. Then the upper part of the upper 3 in the order tip, side and heel is lasted utilising the polyester and polyamide based thermoplastic adhesive. In the end the lasted boot upper 3 is left to set.

In further stage of the boot manufacture the middle sole 5 of the upper part of the system made from a composite material containing the Kevlar textile and middle sole 6 of the lower part of the system made from porous polyolefin foam material are joined with the boot upper 3 by means of a solvent adhesive. In conclusion the half sole 7 with a fixed Kevlar fabric and milled out holes is stuck on using a solvent adhesive.

The completed boots are finished, sock lining 9 is inserted and the boots are laced up.

CLAIMS

1. An anti land-mine boot comprising an upper with a lasting insole and a half sole attached to the said upper by means of a system of at least two middle soles characterized in that the lasting insole (2) and/or at least one of the middle soles (3, 6) are made from a composite comprising at least three layers of para-aramide fabric fixed in a polymer matrix, upper (3) incorporates at least one layer of para-aramide reinforcing textile (4) between lining and upper material, the lining with these interlayers being covered with at least three layers of para-aramide fabric in the walking part of the boot. The edge parts (8) of the three layers of the para-aramide fabric divided about their circumference are turned up and oriented in such a way that the circumferential joints of the turned up edge parts are shifted in separate layers and overlapped, and further that in the region of tip, heel and/or insole, protective segments (1) are incorporated in the boot structure, the segments (1) being made from a composite comprising at least one layer of para-aramide fabric fixed in the polymer matrix and the bottom part of the boot containing a system of middle soles (5, 6) and a half sole (7) attached to the said middle soles (5, 6), at least one of the middle soles (5) of the upper part of the system being made from a composite material and at least one of the middle soles (6) of the lower part of the system being made from a polymer foam material.
2. The boot as in claim 1 further characterised in that at least one layer of para-aramide fabric is fixed in the half sole (7) structure.
3. The boot according to claim 1, characterised in that the said boot is completed with sock lining (9) made from a composite material comprising at least one layer of para-aramide fabric fixed in the polymer matrix, the sock lining containing air cells.
4. The boot according to claim 1 through to 3, characterised in that the said para-aramide fabric is made from Kevlar fibres.
5. The boot according to claim 1 and 3, characterised in that the said polymer matrix is an elastomer compound.
6. The boot according to claim 5, characterised in that the said polymer matrix is rubber.
7. The boot according to claim 5, characterised in that the said polymer matrix is polyurethane.
8. The boot according to claim 1 and 3, characterised in that the said polymer matrix is thermoplastic.
9. The boot according to claim 8, characterised in that the said polymer matrix is based on ethylene vinyl acetate copolymer.
10. The boot according to claim 1, characterised in that the middle sole (5) of the upper part of the system has a groove system on the side adjacent to middle sole (6) of the lower part made from polymer foam material.

11. The boot according to claim 1, characterised in that the middle sole (5) of the upper part of the middle sole system is made from a composite material containing para-aramide fabric.
12. The boot according to claim 1, characterised in that the middle sole (6) of the lower part of the middle sole system is made from a material based on elastomer foam.
13. The boot according to claim 1, characterised in that the middle sole (6) of the lower part of the middle sole system is made from a material based on polyolefin foam.
14. The boot according to claim 13, characterised in that the material of middle sole (6) of the lower part of the middle sole system based on polyolefin foam is ethylene vinyl acetate copolymer.

FIG. 5

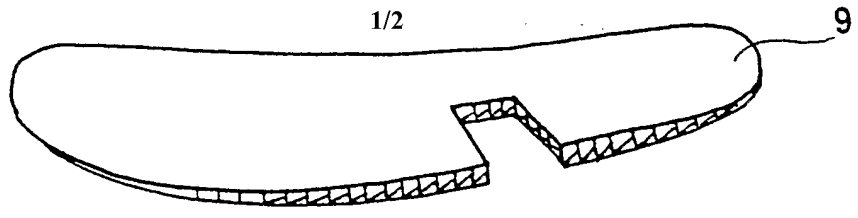


FIG. 1

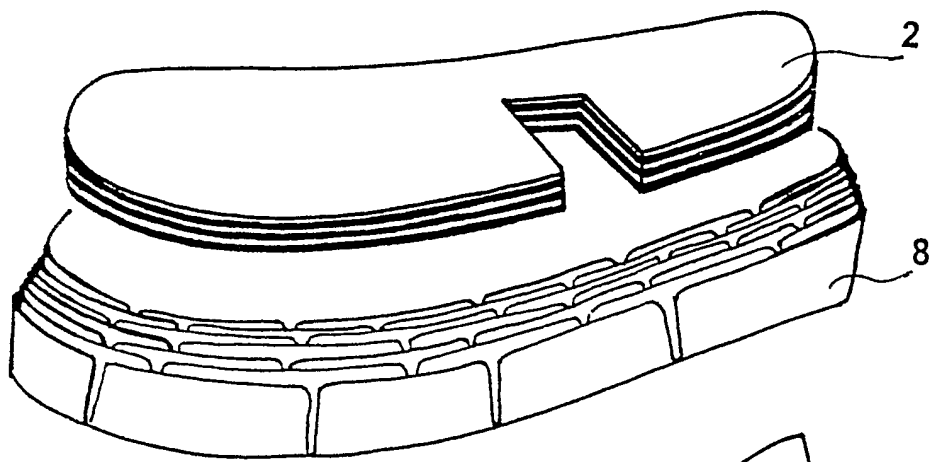


FIG. 6

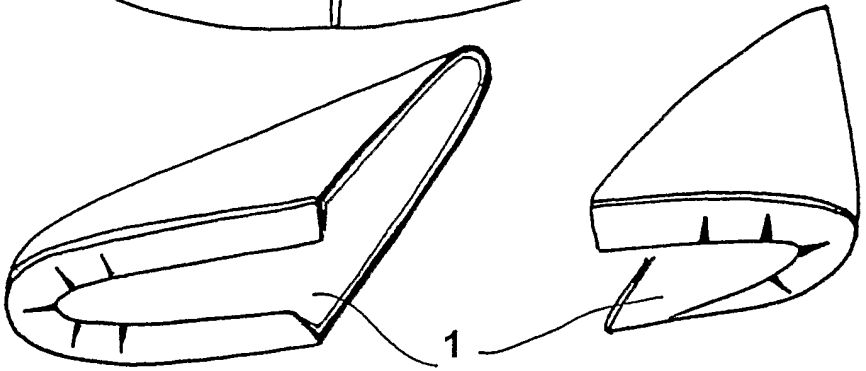


FIG. 2

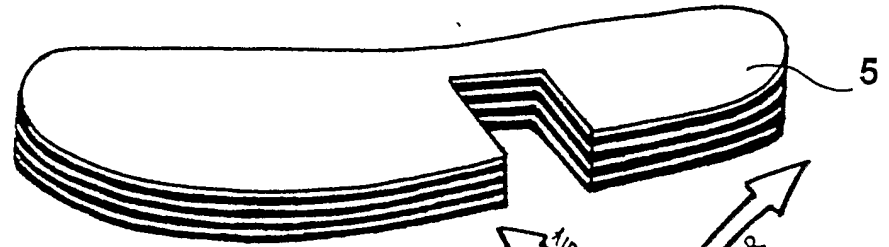


FIG. 3

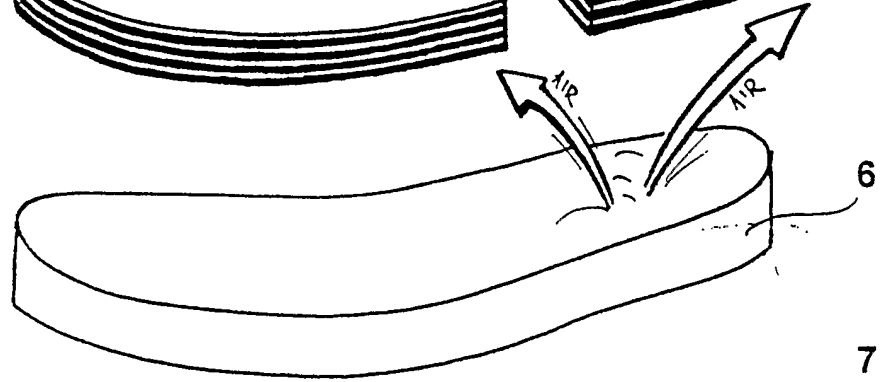


FIG. 4

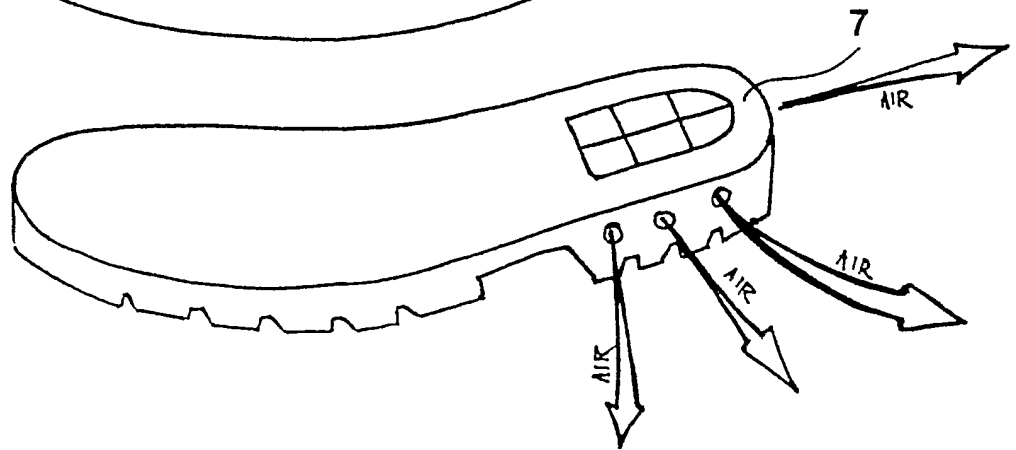
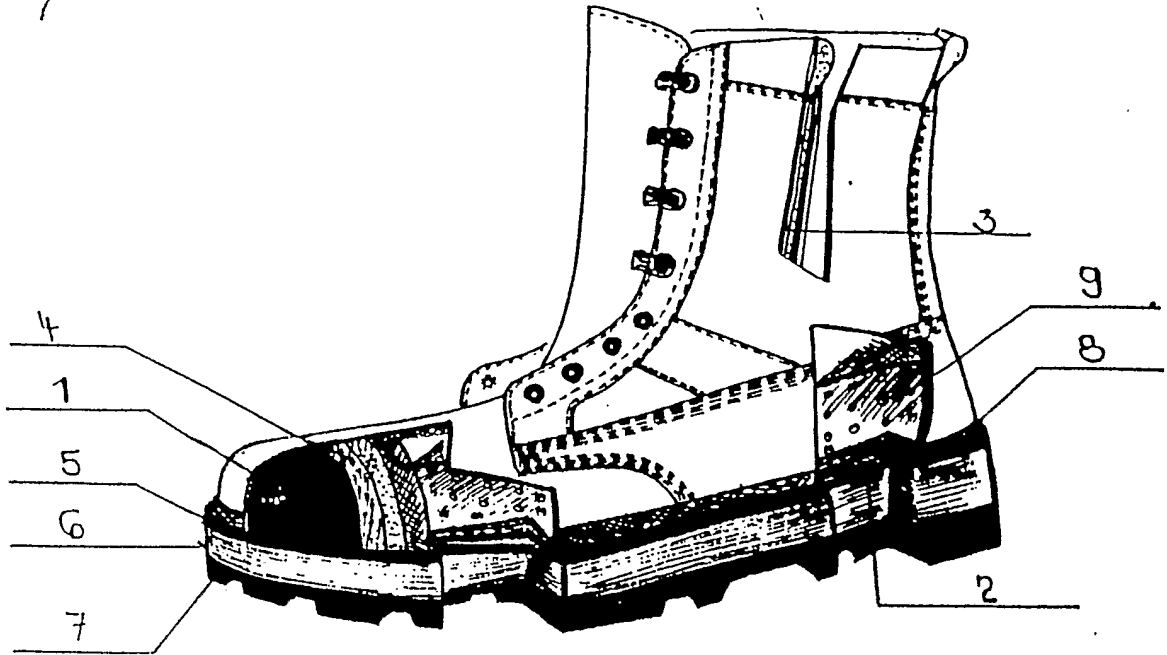


FIG. 7



INTERNATIONAL SEARCH REPORT

International Application No
PCT/CZ 02/00056A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A43B7/32 F41H11/12

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)
IPC 7 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 practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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 Further documents are listed in the continuation of box C. Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

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