

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11)

EP 0 995 073 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:

14.05.2003 Bulletin 2003/20

(21) Application number: **98933419.8**

(22) Date of filing: **17.07.1998**

(51) Int Cl.7: **F41H 1/00**

(86) International application number:
PCT/CA98/00694

(87) International publication number:
WO 99/004216 (28.01.1999 Gazette 1999/04)

(54) **ANTI-PERSONNEL MINE FOOT PROTECTION SYSTEMS**

SCHUTZVORRICHTUNG FÜR FÜSSE GEGEN ANTIPERSONENMINEN

SYSTEMES DE PROTECTION DU PIED CONTRE LES MINES ANTIPERSONNELLES

(84) Designated Contracting States:
DE FR GB

(30) Priority: **18.07.1997 CA 2210868**
20.04.1998 US 63473

(43) Date of publication of application:
26.04.2000 Bulletin 2000/17

(73) Proprietor: **Med-eng Systems Inc.**
Ottawa, Ontario K1H 1E1 (CA)

(72) Inventors:

- **MAKRIS, Aristidis**
Nepean, Ontario K2J 4C3 (CA)
- **L'ABBE, Richard, J.**
Ottawa, Ontario K1G 5L3 (CA)
- **VOISINE, Pierre**
Limoges, Ontario K0A 2M0 (CA)
- **SHAANAN, Gad**
Westmount, Quebec H3Y 1P1 (CA)

- **DUBEAU, Serge**
Montreal, Quebec H2L 3M4 (CA)
- **DE GAGNE, Charles**
Montreal, Quebec H1W 2B5 (CA)
- **HUNZIKER, Derek**
Montreal, Quebec H3X 2L2 (CA)
- **KLEINE, Harald, Hermann**
Ottawa, Ontario K1G 4B5 (CA)
- **ORBAN, Benoit**
St. Laurent, Quebec J4P 2S6 (CA)

(74) Representative: **Altenburg, Udo, Dipl.-Phys. et al**
Patent- und Rechtsanwälte
Bardehle - Pagenberg - Dost - Altenburg -
Geissler - Isenbruck,
Galileiplatz 1
81679 München (DE)

(56) References cited:
US-A- 2 720 714 **US-A- 3 516 181**

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 0 995 073 B1

Description

[0001] This invention relates to a new or improved system to provide foot protection against anti-personnel land mines. The invention is particularly intended for use by military specialists involved in mine clearance operations, although it is likewise suitable for use by other military and civilian personnel.

Description of the Prior Art

[0002] For many decades the laying of mine fields has been used by various military organizations both official and irregular to deny access or to inhibit movement of enemy personnel in selected locations. The mines are buried or otherwise camouflaged and are designed to explode when actuated by the presence of enemy personnel, being triggered by various means such as trip wires, pressure sensors, etc. Larger mines are deployed for the purpose of destroying or disabling trucks and tracked armoured vehicles, but these mines are in some respects of lesser concern since they are not likely to be triggered by an individual's stepping on them.

[0003] Well organized official national armies when deploying a mine field make a practice of preparing a map indicating the location of each mine that is laid, both for the safety of their own personnel, and also with a view to removing the mines after a conflict situation has been resolved. However other military organizations and especially guerillas too often do not prepare proper maps of the location of mines that have been deployed and make no effort whatever to retrieve previously laid mines. Such abandoned mines therefore remain in place constituting for many years a hazard to the lives of wild animals, livestock, and people residing in the vicinity. Every year thousands of people are accidentally killed or maimed by such abandoned anti-personnel mines, and furthermore the presence of mines denies people access to or utilization of large tracts of land.

[0004] The clearance of mine fields is extremely dangerous work and is dealt with by specially trained military personnel who are skilled in de-activation and removal or safe detonation of mines. However no level of skill can guarantee against accidental detonation of an anti-personnel mine which has not been detected or which is of a design that is unfamiliar to the mine disposal operative, and accordingly it is necessary to equip the operative with as much protective clothing as is possible without excessively restricting his freedom of movement. Thus it is usual to protect mine clearance operatives by providing clothing and padding which will absorb the blast forces and projectiles created by anti-personnel mines. Such equipment includes protective helmets and footwear.

[0005] Experience has shown that the feet of operatives working on mine clearance are particularly vulnerable to injury, and various proposals have been brought forth to reduce such injuries. Examples of prior proposals for protective footwear are shown in U.S. Patents 2,720,714 Krohn et al., 3,318,024 Fujinaka et al and 3,516,181 Jordan.

[0006] None of the prior proposals for protective footwear has been entirely satisfactory. Some proposals are too weighty and unwieldy while others do not provide a sufficient spacing of the feet of the operative above the ground in which a mine may be embedded, and still others do not provide sufficient stability for support of the operator. None of the prior protective footwear can avoid the possibility that the operative may tread on and thus detonate a mine located immediately underneath his foot.

[0007] Although U.S. 3,516,181 Jordan shows protective foot gear that is designed to support the foot of the operative at a substantial distance above the ground surface, it clearly incapable of providing stable support due to the very narrow width of the support member 22, which is more in the form of a blade than a platform and thus will not provide very stable support. Furthermore, since Jordan's support member 22 is continuous, it will not even provide stable support in the longitudinal direction, e.g. if it is placed upon a small stone or the like. Additionally, since there is material continuously between the lower surface 23 of the support 22 and the operative's foot, the blast force of any mine detonated by the foot gear will be transmitted through the foot gear upwardly to the operative's foot.

SUMMARY OF THE INVENTION

[0008] It is an object of the present invention to provide a protection system to protect the foot of a user against anti-personnel mines and of the like which reduces the possibility of a mine detonation occurring directly beneath the foot of the user.

[0009] This object is achieved by a protection system according to claim 1.

[0010] Further advantageous embodiments of the invention are laid in the dependent claims.

[0011] The present invention provides a protection system to protect the foot of a user against anti-personnel mines and the like, said system comprising: a frame configured to receive and be attached to a user's footwear to support the foot in a location that is at a height of at least about 10 cm above a ground surface; said frame carrying ground-engaging elements that have overall extents in longitudinal and lateral directions that are sufficient to provide stable support for said frame on a supporting ground surface; said ground-engaging elements being discrete and spaced apart, and said frame having an underside that is spaced upwardly in relation to said ground-engaging elements so

as to have clearance above the supporting ground surface. According to a preferred embodiment at least parts of said system are compliantly deformable to accommodate irregularities in the supporting ground surface. The system preferably also includes blast protecting material completely covering the underside of the foot location.

[0012] Preferably the ground-engaging elements of the system are spaced forwardly and rearwardly relative to the foot location so that they will not cause detonation of an undetected mine that is immediately below the foot of the operative. The front ground-engaging elements are positioned between about 10 and 40 cm preferably between about 15 and 30 cm, and most preferably about 25 cm forwardly of the front of the foot location; the rear ground engaging elements are spaced to the rear of the foot location by similar amounts, and the front and rear ground-engaging elements are spaced apart longitudinally by at least about 20 cm, preferably between about 25 and 80 cm, and most preferably about 35 cm.

[0013] The ground-engaging elements may comprise forward and rearward pairs of laterally spaced pods which can provide a stable support for the system even upon irregular ground surfaces. These pods preferably have rounded undersides to engage the ground and are carried on arms that are somewhat resilient.

[0014] The ground-engaging elements preferably comprise resilient members that can include chambers filled with compressible gas as in a bellows, or foamed plastic to permit some ground surface versatility. In some cases, rigid contact points may also be used, dependent on the terrain.

[0015] The blast-protecting material on the underside of the foot location preferably has an underside that tapers convexly towards a rounded lower end presenting a downwardly angled outer surface that will have a deflecting effect upon fragments which may be hurled upwardly from an exploding mine. The blast-protecting material preferably comprises multiple layers of foam plastic or other energy-absorbing materials having an overall thickness in the range 3 to 15 cm and preferably about 10 cm, although in some embodiments the thickness may be as little as 1 cm.

[0016] Overall it is desirable that the protection system is lightweight and not excessively cumbersome to use. The system supports the foot of the operative at a height of at least 10 cm and preferably about 12 cm, in some cases to provide enhanced protection this height may be 20 cm or more above the ground surface; this spacing together with the forward and rearward disposition of the ground engaging elements and the blast protecting material on the underside of the foot location combine to greatly reduce the likelihood of injury to the foot in the event that mine detonation is occasioned by the ground engaging elements, or otherwise occurs in the immediate vicinity of the feet of the operative.

[0017] In terms of protection afforded to the user's foot, it is evident that the greater the spacing vertically and horizontally between the user's foot and the location of an exploding mine, the less the impact of the blast effect upon such foot. However the cost of providing the foot protection system obviously will increase as its size and height increases and as the thickness of the blast protection on the underside of the foot location is increased, and furthermore these factors also affect the overall weight of the article and thus its convenience in use. If the dimensions of the foot protection system are too great, it becomes costly to produce and difficult to use. Thus while a system that supports the foot 20 or more centimeters above the ground surface may be desirable from the safety standpoint, from the standpoint of usability, stability and cost, it is thought that many customers might prefer a system providing a height in the range 10 to 12 cm, with a thickness of blast protecting material on the underside of the foot location of from 1 to 5 cm.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The invention will further be described, by way of example only, with reference to the embodiments shown in the accompanying drawings wherein:

Figure 1 is a perspective side view of a first embodiment of the foot protection system in accordance with the invention;

Figure 2 is a perspective view of a second embodiment of the foot protection system in accordance with the invention, shown with a boot supported thereon;

Figure 3 is a side elevation of the embodiment shown in Figure 2;

Figure 4A is a plan view corresponding to Figure 3;

Figure 4B is a sectional view taken on the line B-B of Figure 3;

Figure 4C is an enlarged sectional view taken on the line C-C in Figure 4B;

Figure 5 is a perspective view of the frame portion of an alternative embodiment of the foot protection system;

Figure 6A is a side view of the frame portion of a third alternative frame portion of the protection system, Figure 6B being a fragmentary view of a foot portion of the frame, and Figure 6C being an enlarged sectional view of a foot portion of the frame;

Figures 7A, 7B and 7C are views corresponding to 6A, 6B and 6C showing a fourth embodiment of the frame;

Figures 8A, 8B and 8C are views corresponding to 6A, 6B and 6C showing a fifth embodiment;

Figure 9 is a view corresponding to Figure 5 showing a sixth embodiment;

Figure 10 is a perspective view showing a seventh embodiment of the foot protection system;

Figure 11 is an underneath plan view of the embodiment of Figure 10; and

Figure 12 is a sectional view taken on the line XII-XII of Figure 13.

Figure 13 is a longitudinal sectional view of the embodiment of Figure 10 taken on the line XIII-XIII in Figure 12; and

Figure 14 is a plan view of this embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] The foot protection system shown in Figure 1 generally indicated at 10 comprises a framework 11 that is of inverted U-shape as seen in side view the framework comprising downwardly and forwardly curved front legs 12 and downwardly and rearwardly curved rear legs 13. The lower end of these legs carry ground-engaging elements in the form of flat pods 14, 15 respectively, which are upwardly curved at their forward ends and which can pivot through at least a limited angular range about horizontal axes to accommodate to irregularities in the ground surface upon which the system may be placed.

[0020] As indicated at 16, each side of the framework is telescopically adjustable so as to selectively change the longitudinal spacing between the front and rear pods 14, 15 within a limited range. The outboard edges of the rear pods 15 are somewhat flattened and for ease of use, the overall width across the rear pods is less than that across the front pods by an amount of at least about 5 cm.

[0021] The framework 11 defines a foot location generally indicated at 18 which is designed to receive the foot of an operative and secure the protection system to the foot. In the embodiment of Figure 1 the foot location is designed to receive a foot that is shod in a boot or the like, but obviously could be modified to include built-in footwear (not shown). The framework includes a front cross member 19 and a similar rear cross member (not shown) to provide structural rigidity. A foot receptor sub-frame 21 is attached to the front cross member 19, such attachment including a pivotal connection to allow the sub-frame 21 a limited range of pivotal movement about a generally horizontal transverse axis at its forward end.

[0022] The foot protection system shown in Figure 1 is designed to receive the left foot of an operative, and therefore to provide a more natural foot attitude, the foot receptor is toed-out by a few degrees, e.g. between 5 and 10 degrees.

[0023] The underside of the foot location is shielded from the effects of a mine explosion by a shield 25 of lightweight blast absorbing material such as a lamination of med/high density and lower density polystyrene, polyethylene, polyurethane foams, having a thickness of 5 cm to 15 cm and densities in the range 10 to 130 kg/m³. The shield 25 entirely covers the underside of the foot location providing continuous protection from side-to-side and from front-to-rear beneath the foot receptor 21. The shield has front and rear upwardly curved extensions 26, 27 which provide protection to the foot location in the case of mine detonations that occur to the front and to the rear thereof. Also the shield can be extended outwardly and upwardly at the sides (not shown) of the foot location to add further protection.

[0024] From the foregoing description and the accompanying drawings it will be appreciated that the foot protection system disclosed in relation to Figure 1 provides a high degree of protection to the foot of an operative. The fact that the front pods 14 and rear pods 15 are displaced longitudinally and do not lie immediately beneath the foot of the user, and that the foot location is displaced a substantial distance (i.e. at least 10 cm and as shown in Figure 1 20 cm) above the supporting ground surface combine to greatly attenuate the blast force upon the user's foot of any mine that is initiated through pressure exerted by the supporting pods 14, 15.

[0025] The foot protection system 10 should be as compact and as lightweight as is consonant with safe operation by mine clearance personnel. It should not be excessively heavy or unwieldy since it could be worn by individuals for shifts of several hours. Also the system 10 should preferably not be fabricated from magnetisable material since such could interfere with operation of metal detector equipment that is commonly employed in mine clearance operations. In the embodiment of Figure 1 the framework 11 is composed essentially of lightweight aluminum or aluminum alloy tubes or composite material structures, the pods 14 and 15 being of similar material.

[0026] Referring now to Figures 2, 3 and 4, the foot protection system 100 shown in these views comprises a platform 101 that is supported generally horizontally upon a ground surface by four outwardly and downwardly curved legs comprising two front legs 102 and two rear legs 103, each leg carrying a ground engaging pod 104. As shown in Figure 4A, the platform 101 has a horizontal area that can be larger than the footprint 105 of a boot, the footprint shown in Figure 4A representing a boot of overall length of about 32 cm, although for convenience in use the dimensions of the foot platform should not greatly exceed the physical dimensions of a wearer's boot. In Fig. 4A, the platform shown is intended to accommodate a wide range of boot sizes.

[0027] The front part of the platform 101 has fixed thereto a flexible sole plate 106, which is of uniform thickness and of a width and length just smaller than the top of the platform. The sole plate is essentially flush with the side walls of the structure (101). The sole plate supports the boot about 5 mm above the top of the platform 101 and extends under the sole and heel of the boot. The sole plate 106 is attached to the platform 101 only at its forward end and can be pivoted by flexure about a transverse axis.

[0028] On the rear part of the sole plate 106 there is an upstanding forwardly open U-shaped heel stopper 114 that

is formed integrally with the plate 106 and that has in each of its opposite sides a large rectangular recess 116 to accommodate a corresponding hook plate 112 to delimit a range of pivotal movement of the plate 106. Each hook plate 112 is formed integrally with a corresponding side of the platform 101 and projects into the corresponding rectangular recess 116, the upper end of the hook plate having a detent 107 which projects laterally inwardly to cooperate with the upper side of the sole plate 106 to limit the range of upwards movement of the rear part of the sole plate 106 (and with it the heel of the boot 118) to correspond to the pivotal movement of the foot joint of the user as will occur in a normal walking motion. The position of the detents 107 above the platform 101 will determine the maximum range of upwards movement of the heel. By providing for this movement the foot protection system will be found to be much more comfortable for use by the operator.

[0029] The sole plate 106 carries a mounting support for a binding structure by means of which the assembly can be secured to the boot 118 of a user, the binding comprising an adjustable instep strap 120 which spans the sides of the sole plate 106 across the instep portion of the boot and has ends that are adjustably connected by suitable fasteners (not shown) at selected locations in the sides of the sole plate 106 so that the binding can be adapted to accommodate boots of various sizes. The strap 120 is adjusted in length to snugly enclose the boot, and is secured by suitable means such as buckles, ratchet mechanisms, or Velcro fasteners for example. An upper binding portion comprising a U-shaped ankle support 122 is adjustably pivotally attached at its sides to the top of the heel stopper 114 and also carries an adjustable strap 124 by means of which the apparatus can be snugly secured around the boot and the lower leg of the user. It will be understood that the ankle support 122 is pivotal relative to the heel stopper 114 to accommodate normal pivotal movement and adjustment of the lower leg with respect to the foot of the user.

[0030] The platform 101 is of overall canoe shape as is best seen in Figures 2, 3 and 4B, having a length and a width that are greater than those of any boot that will be accommodated, the sides of the platform tapering convexly in the downwards direction as seen in the drawings to present a somewhat wedge-like aspect towards the ground, as seen particularly in Figure 4B, this being important to provide a deflection laterally outwardly, or forwardly or rearwardly, of the pressure wave loading, as well as of solid particles and fragments hurled upwardly e.g. by the explosion of a land mine under the foot protection system.

[0031] The internal construction of the platform is shown in Figure 4B, the platform comprising a molded composite material shell fabricated of e.g. glass fibre, aramid fibre or plastic, enclosing a composite core of blast absorbing material comprising a lower core section 128 of low density foam plastic material and an upper core section 130 of a foam plastic material that is of much lower density than the lower section 128. Suitable materials of the core sections are:

lower section 128	polyethylene of density	65-130 kg/m ³
upper section 130	polyethylene based foam	25-45 kg/m ³ density

[0032] By judicious selection of the shape and material of the downwardly facing surfaces of the platform 101 and of the nature and density of the materials of the core sections 128, 130, the damaging effects of blast pressure loading and fragmentation pieces hurled upwardly by an exploding mine can be very much diminished so that the danger of injury to the feet or lower limbs of the user is correspondingly reduced. Moreover, the blast wave loading on the foot itself is attenuated by the energy absorbing foam type materials beneath the foot platform and the possibility of damping of any relative motion between foot and platform. A single core section may be used or more than two types or densities of core materials to attenuate the blast can be included.

[0033] The shell of the platform 101 is fabricated, e.g. by molding from a suitable composite plastic or non-ferrous metal material, and the core sections 128, 130 can be molded within the shell 101.

[0034] The front legs 102 and the rear legs 103 are of similar construction each comprising an elongate curved member having an upper end that is substantially horizontal and is attached to the underside of the platform 101, the leg curving away from the platform and laterally outwardly and downwardly to terminate in the pod 104. As seen in Figure 4C, each of the legs 102, 103 comprises a hollow molded plastics section of somewhat triangular outline having convex lower sides 132, 134 which offer a downwardly oriented wedge-like profile to maximize blast deflection. The pod 104 attached to the lower end of each leg 102, 103, is of soft construction and may be fabricated in a compressible lightweight foam plastic material, and has on its underside a tread rounded piece 136 having an array of projecting integral studs 136.1 thereon to provide improved traction between the pod and the ground surface. The tread piece 136 can be provided in the form of a hollow rounded cover fabricated e.g. in polyethylene and fixed to the associated stud 104 in a secure manner, yet releasable when the tread piece has to be replaced. The rounded configuration of each tread piece 136 enables the foot protection system to more readily adapt and find stable support upon irregular surfaces, and this effect is enhanced by providing a measure of height adjustability as between the different pods 104, such height adjustability being provided for by a somewhat resilient construction of the legs 102, 103. The pod itself can perform the function of a spring or a bellows, or may serve as a rigid contact point with the ground.

[0035] The foot protection systems described herein counteract the effects of exploding mines upon the feet of op-

eratives in two ways: the configuration of the platform 1 and the legs 102, 103 space the user's foot, represented by the boot 118, a substantial distance away from any mine that may be exploded by one of the pods 104, and the shape and construction of the legs 102, 103 and in particular of the lower side of the platform 101 help to deflect and/or to absorb the energy of the blast wave pressure and mine fragments. With reference to Figure 3, the system supports the boot at a height H above the ground surface, and the pods 104 are spaced apart by a distance L in the longitudinal direction. The protective effects of the system are enhanced with increases in both of the dimensions H and L, but these dimensions cannot be made too large or else the system will become unwieldy and unstable to the user. It will be understood that in mine clearance operations, the user will have to wear the foot protection system for many hours, and will also have to be able to move about in more or less unrestricted manner across the ground surface that is being cleared. Thus as a practical matter it has been determined that the dimension H should be within the range 10 to 40 cm, and preferably from about 10 cm to about 20 cm, and the dimension L should be within the range 25 to 80 cm and preferably about 50 cm. Furthermore it is desirable for the pods 104 to be spaced longitudinally away from the foot location, such spacing being represented by the dimensions C in Figure 3, C being in the range from 0 to 25 cm, preferably between 2 and 15 cm, and most preferably about 10 cm, dependent on the size of foot of the wearer.

[0036] As has been noted above, from the point of view of safety, it is desirable to maximize the dimension H. However as H increases, the convenience of use and stability of the foot protection system are reduced, and thus while it is preferred that H should be 20 cm or more, it is thought that practical and useful embodiments of the foot protection system can be provided in which H is as little as about 10 to 15 cm.

[0037] It will be appreciated that in terms of protective effect, the dimensions C and H are interrelated, and for the same protective effect, if the dimension C is increased, then the dimension H can be reduced and vice versa. Referring to Figure 4B, the lateral spacing between the pods 104 is represented by the dimension D, and the overall lateral width of the system is represented by the dimension W. These dimensions also can be varied within relatively wide limits. The dimension W may be anywhere within the range 10 to 40 cm, but is preferably about 25 cm since for widths of 30 cm or more the system becomes a little unwieldy in requiring the user to maintain an uncomfortably large lateral spacing between the left foot and the right foot. The lateral extent W of the rearmost pair of pods 104 may be slightly less (e. g. up to 10 cm) than that between the forwardmost pair of pods 104, and the foot location may be correspondingly "toed-out" by up to 5 degrees, since this makes the system more comfortable for the user in that the user's feet can assume a more natural orientation.

[0038] The vertical thickness (T in Figure 3) of the foam filled platform 101 can likewise be varied within wide limits, and may be anywhere from 2 to 15 cm, and preferably about 5 cm.

[0039] The combined effects of the dimensions C and H are to ensure that there is a substantial spacing, S in Figure 3, between the pods and the closest adjacent part of the foot location, since this distance S and the deflection angle is critical factors in reducing injuries. It has been determined that the distance S should be not less than 10 cm, and for practical reasons no more than 40 cm, preferably in the range 15 to 30 cm and most preferably about 25 cm. Although not shown in Figure 3, it will be understood that a similar spacing S should be provided between the rear pods 104 and the heel of the boot of the user.

[0040] The dimensions C and S will vary somewhat according to the size of the boot 118, and the dimensions and ranges discussed are established in relation to a size 12 boot (length 30 cm). The vast majority of users will have boot sizes less than 12, so that an additional margin of protection is available.

[0041] Alternative embodiments of the framework are shown in Figures 5 through 9. Referring to Figure 5 there is shown a framework 31 of a foot protection system which is equivalent in function to the framework 11 of Figure 1. For clarity of illustration, the foot receptor sub-frame and related parts are omitted from these figures. However these parts may be similar in function to those described in relation to Figures 1 and 2 to 4.

[0042] The framework 31 is of lightweight composite construction comprising an upper layer 32 of plastic or of composite materials (aramid, glass, carbon or polyethylene fibres) construction, at least one intermediate layer 33 (thickness 5 mm to 5 cm) of a rigid lightweight foam plastic material, and a lower layer 34 (thickness 5 mm to 15 mm) of blast protecting material. The composite layered material may be fabricated in flat sections which are subsequently cut to shape and bent into the arched configuration as shown in Figure 5. The framework may include an integrally molded toe cap 35. Forwardly of the toe cap the framework divides into two curved limbs 36 which terminate in a transverse ground-engaging pad assembly 37. At the rear of the framework 31 there are two laterally spaced downwardly curved limbs 38 which terminate in a rear ground-engaging pad assembly 39. The pad assemblies 37, 39 have a generally rectangular footprint extending transverse to the length of the frame, and are fabricated to be of compliantly compressible structure. For this purpose the pad assemblies may constitute gas filled structures, or compressible foam.

[0043] It will be appreciated that the limbs 36 and 38 are of resiliently flexible composition, and this combined with the inherent compressibility of the pad (or foam) assemblies 37, 39 ensures that the framework 31 can readily accommodate itself to irregularities in the ground surface upon which it is supported.

[0044] Referring to Figures 6A, 6B and 6C, the framework 41 shown here is similar in construction and configuration to that shown in Figures 2 to 5 and will not be described further. In Figures 6A to 6B, the ground-engaging elements

are formed by generally rectangular feet 42, 43 which are pivotally attached to the lower ends of the forward and rearward limbs 44, 45 respectively by pivot pins 46, 47 respectively received in rounded end pieces 48, 49 carried at the lower ends of the limbs 44, 45. The feet 44, 45 have upwardly curved front ends and comprise a thin profiled traction pad 50a over a lightweight plastic backing piece 50b.

[0045] Referring to Figures 7A, 7B and 7C there is shown a foot protection system framework 51 which is similar in construction and configuration to those discussed above in relation to Figures 5 and 6. At the lower end of each of the legs 52, 53 is a pad assembly in the form of a somewhat rectangular air filled compartment 54, or readily compressible pod, e.g. of foam, attached to the lower end of the associated leg by an adhered backing piece 56 which is bonded to the top of the pod (air bag) 54 and to the corresponding leg 52, 53.

[0046] The framework 61 shown in Figure 8A is of similar shape and construction to that shown in Figures 5, 6A and 7A, defining spaced pairs of front legs 62 and rear legs 63. The ground-engaging feet 64 in Figures 8A to 8C are similar in construction to those of Figures 6A to 6C comprising traction pads adhered to lightweight plastic backing pieces. On the upper side of each of the feet 64 there is a tubular deformable bellows 66 forming a connection with the lower end of the leg 62, 63 through a suitable connecting layer 67. The backing piece of each foot 64 is preferably of high density foam material, the bellows being of elastic configuration and therefore capable of a large range of pivotal deformation about any horizontal axis.

[0047] The framework 71 shown in Figure 9 is generally similar in shape and construction to the examples of Figures 5, 6A, 7A and 8A and may include any of the arrangements of traction pads, air chambers, bellows and the like as disclosed therein. The Figure 9 embodiment however is further characterized by the provision of a rectangular platform 74 which is attached to the framework 71 and projects horizontally over the front and rear legs 72, 73. The platform 74 can be made integral with the central part of the framework, and may incorporate a limited degree of resilience, the ends 76, 77 being spaced above the corresponding lower ends of the front and rear legs 72, 73. The platform thus provides added protection in the event that the legs 72, 73 are broken off by an exploding mine. In this event the front and rear platform ends 76, 77 will act to prevent broken fragments being projected directly upwardly towards the operative, but rather will deflect them outwardly away from the operative. The platform, although being structurally much lighter than the legs is nonetheless likely to be effective for the intended purpose by virtue of the fact that it is of resilient construction and is at a greater spacing above the ground surface than are the legs. Suitable materials for the platform are composite materials similar to those used for the shell in Figs. 2-6 (e.g. comprised of aramid, glass or plastic fibres).

[0048] Figures 10 to 14 illustrate a foot protection system that is somewhat similar to that shown in Figures 2 to 4 but is designed to support the user's foot at a height of just over 13 cm above the supporting ground surface 80 (Fig. 12) and to incorporate a platform that is considerably thinner than the one shown in Figures 2 to 4.

[0049] Referring to Figures 10 to 14 the foot protection system 81 comprises a platform 82 on the upper side of which is a sole plate 83 similar in form to the sole plate 106 of Figures 2 to 4, the sole plate overlying and being substantially coextensive with the platform and being connected thereto by fastening means in the form of plastic screws 84 located at the mid sole or forwardly so that the rearward part of the sole plate is free to flex and pivot upwardly about the screws 84. As before the sole plate 83 carries a binding structure 85 (similar to that described in relation to Figures 2 to 4) for securing a boot 118 therein, and may also include a detent structure (not shown) to limit the upwards movement of the heel portion of the boot and sole plate relative to the platform 82.

[0050] As seen in Figure 12, the platform 82 is relatively thin, having overall a general thickness of approximately 5 cm, although its protective effect is enhanced to some extent by the sole plate 83 which typically comprises a sheet of polyethylene or similar flexible plastic material of thickness 2.5 to 5 mm. As shown in Figures 12 and 13, the lower portions 85.1 of the binding 85 can be molded integral with the sole plate 83. The structure of the platform is most clearly seen in Figures 12 and 13 as comprising an outer shell or canoe 82.1 of molded plastic material of a thickness between 8 and 10 mm surrounding a foam interior 82.2, the upper edge of the shell 82.1 extending slightly above the sole plate 83.

[0051] As seen in Figure 14, the overall dimensions of the platform 82 are approximately 38 cm in length and 14.5 cm in width, the height of the upper surface of the sole plate above the ground surface 80 being approximately 13 cm.

[0052] The underside of the platform 82 is formed with a pair of generally V-shaped recesses 87, 88 to receive V-shaped front and rear leg assemblies 89, 90 which are secured in position by nylon fasteners 91 which connect each to the platform 82.

[0053] As seen in Figure 12, the undersides of the platform 82 and leg assemblies form a downwardly projecting convex curvature 92 (Figure 12) which is designed to help deflect blast effects laterally.

[0054] As best seen in Figure 13, the leg assemblies 89, 90 include integral legs 93 each terminating in a screw-threaded stud 93.1 carrying pods 94, similar to the legs and pods as described in relation to the embodiment of Figures 2 to 4. The pods 94 are threadably attached to the studs 93.1 and can therefore be removed when required. The leg assemblies 89, 90 may be formed as hollow roto-molded plastic components, and have upper sides molded to fit snugly within the recesses 87, 88 on the underside of the shell 82.1 so as to be rigidly and securely attached to the latter by means of the nylon fasteners 91. The studded pods 94 are of molded polyurethane, having integrally formed attachment

threading therein.

[0055] Overall, the foot protection system of Figures 10 to 14 is fabricated substantially entirely in lightweight plastic materials to minimize the amount of damage caused by parts which break free during an explosion. Typically, an undetected mine could be triggered by contact by a front one of the pods 94, and explosion of the mine would most probably result in destruction of that pod and its associated leg 93, fragments of which would be hurled upwards. However the damage caused by such fragments is minimized because of their lightweight construction, and in any event destruction of the foot protection system does not produce any sharp edged metal fragments.

[0056] Although some presently preferred exemplary embodiments are described in the foregoing in relation to the drawings, it will be understood that the invention is capable of modification in its details, and therefore encompasses all embodiments falling within the ambit of the appended claims.

Claims

1. A protection system to protect the foot of a user against anti-personnel mines and the like, said system comprising:
 - a frame (11; 101; 31; 41; 51; 61; 71; 82) configured to receive and be attached to a user's footwear to support the foot in a location that is at a height (H) of at least about 10 cm above a ground surface;
 - said frame carrying ground-engaging elements to provide stable support for said frame on a supporting ground surface;
 - characterized in that** said ground-engaging elements (14; 15; 104; 37; 39; 42, 43; 54; 64; 72, 73; 94) are discrete and spaced apart, and said frame having an underside that is spaced upwardly in relation to said ground-engaging elements so as to have clearance above the supporting ground surface.
2. A protection system as claimed in claim 1 wherein at least parts (102, 103; 36, 38; 44, 45; 53; 62, 63, 66; 72, 73; 93) of said system are compliantly deformable to accommodate irregularities in the supporting ground surface.
3. A protective system as claimed in claim 1 or claim 2 further including blast protecting material (128, 130; 34) completely covering the underside of said foot location.
4. A protective system as claimed in any one of claims 1 to 3 wherein the underside of said frame is aerodynamically shaped (Fig. 4B) to deflect blast wave loading and fragments.
5. A protection system as claimed in any one of claims 1 to 4 wherein a forwardmost (14; 104; 37; 42; 54; 64; 72; 94) of said ground-engaging elements is located forwardly of said foot location.
6. A protection system as claimed in any one of claims 1 to 5 wherein a rear-wardmost (15; 104; 39; 43; 54; 64; 73; 94) of said ground-engaging elements is positioned rearwardly of said foot location.
7. A protection system as claimed in any one of claims 1 to 6 wherein said ground-engaging elements comprise pairs of laterally spaced pods (104; 42, 43; 54; 64; 72, 73; 94), or a single wider element (37, 39) in place of a pair of pods.
8. A protection system as claimed in any one of claims 1 to 7 wherein said foot location is defined by a receptor (106; 83) that is movable to accommodate upwards swinging movement of the foot of the user about a mounting (108; 84) at a forward part of said receptor.
9. A protection system as claimed in claim 8 wherein said receptor comprises a layer of flexible plastic material (106; 83) having a forward end that is connected to said platform, said layer being sized to lie beneath the user's foot.
10. A protection system as claimed in claim 8 or claim 9 wherein said receptor furthermore includes a binding structure (120, 122, 124; 85) configured to engage around the foot and ankle of the user.
11. A protection system as claimed in any one of claims 1 to 10 wherein said frame is fabricated from a lightweight composite, plastic or metal material.
12. A protection system as claimed in any one of claims 1 to 9 wherein said frame is of composite construction comprising an upper layer (83) of tough composite or plastics material, a lower layer (126, 82) of blast absorbing

material and at least one inner layer (128, 130) of lightweight foamed plastic, honeycombed aluminum, or other composite material that can readily collapse and absorb energy.

13. A protection system as claimed in any one of claims 1 to 12 wherein said frame is of arch-shaped configuration and is bifurcate at its front and rear ends to define pairs of laterally spaced legs (102, 103; 36, 38; 72, 73; 89, 90) having lower ends which carry said ground engaging elements.

14. A protection system as claimed in any one of claims 1 to 13 wherein said ground-engaging elements comprise in part lightweight foamed plastic material (50b; 64b).

15. A protection system as claimed in any one of claims 1 to 13 wherein there are at least two said ground-engaging elements arranged at a longitudinal spacing which is not less than the length of said foot location.

16. A protection system as claimed in any one of claims 1 to 15 wherein said frame is configured to support the user's foot at a height of from about 10 to 15 cm above the ground surface.

17. A protection system as claimed in any one of claims 1 to 15 wherein said frame is configured to support the user's foot at a height of between about 15 and 30 cm above the ground surface.

18. A protection system as claimed in any one of claims 1 to 17 wherein each of said ground-engaging elements (104; 94) has a rounded underside for engagement with the supporting ground surface.

19. A protection system as claimed in claim 18 wherein said ground-engaging elements include outer shells (94) which are lockingly attached thereto, but selectively removable for replacement, each said shell being of rounded configuration and of a resilient plastic material.

20. A protection system as claimed in claim 19 wherein said pads are fabricated from a material selected from polypropylene, polyurethane, silicone and rubber, and are formed with projections on the outer surfaces thereof to improve engagement with the supporting ground surface.

21. A protection system as claimed in claim 19 or claim 20 wherein said selectively removable shells of the ground-engaging elements are secured in place by locking means (93.1) to prevent accidental removal while in operation.

22. A protection system as claimed in any one of claims 1 to 21 wherein said ground-engaging elements are carried at the ends of arms (102, 103; 93) which are attached to said frame on the underside thereof, each said leg being fabricated of a plastics material and having a limited degree of resilience to enable the system to accommodate to irregularities in the supporting ground surface.

23. A protection system as claimed in claim 22 wherein said legs are arranged in forward and rearward pairs, each pair having two legs which are integrally formed in a V-configuration (89,90) and are releasably fixed to the underside of said frame.

24. A protection system as claimed in any one of claims 1 to 23 having dimensions within the following ranges:

- a) overall length between 30 and 80 cm;
- b) width of between 10 and 40 cm;
- c) distance between front of foot location and a forward ground-engaging element in the range from 5 cm to 40 cm;
- d) a distance from the rear of the foot location to the rearmost ground engaging element of between 5 and 25 cm.

25. A protection system as claimed in claim 8 or in any one of claims 9 to 24 as dependent upon claim 8, wherein said receptor includes an ankle support which is configured to accommodate a limited range of pivotal movement with respect to said receptor thus delimit the range of foot movement about the ankle of the user.

Patentansprüche

1. Ein Protektionssystem, um den Fuß eines Benutzers gegen Antipersonenminen und dergleichen zu schützen, wobei das System aufweist:

einen Rahmen (11; 101; 31; 41; 51; 61; 71; 82), der konfiguriert ist, um eine Fußbekleidung eines Benutzers aufzunehmen und daran befestigt zu sein, um den Fuß an einem Ort zu stützen, der sich bei einer Höhe (H) von zumindest 10 cm über einer Bodenoberfläche befindet;

wobei der Rahmen in den Boden eingreifende Elemente trägt, um ein stabiles Stützen für den Rahmen auf einer stützenden Bodenoberfläche zu gewährleisten;

dadurch gekennzeichnet, dass die in den Boden eingreifenden Elemente (14; 15; 104; 37; 39; 42; 43; 54; 64; 72; 73; 94) diskret und voneinander beabstandet sind, und wobei der Rahmen eine Unterseite aufweist, die nach oben im Verhältnis zu dem in den Boden eingreifenden Elementen beabstandet ist, damit ein Freiraum über der stützenden Bodenoberfläche besteht.

2. Protektionssystem nach Anspruch 1, wobei zumindest Teile (102, 103; 36, 38; 44, 45; 53; 62, 63, 66; 72, 73; 93) des Systems nachgiebig deformierbar sind, um sich an Unregelmäßigkeiten in der stützenden Bodenoberfläche anzupassen.

3. Protektives System nach Anspruch 1 oder 2, welches des Weiteren Explosionsprotektionsmaterial (128, 130; 34) beinhaltet, das die Unterseite des Fußortes vollkommen abdeckt.

4. Protektives System nach irgendeinem der Ansprüche 1 bis 3, wobei die Unterseite des Rahmens aerodynamisch geformt ist (Fig. 4B), um eine Explosionswellenbelastung und -fragmente abzulenken.

5. Protektionssystem nach irgendeinem der Ansprüche 1 bis 4, wobei ein vorderstes (14; 104; 37; 42; 54; 64; 72; 94) der in den Boden eingreifenden Elemente von dem Fußort nach vorne angeordnet ist.

6. Protektionssystem nach irgendeinem der Ansprüche 1 bis 5, wobei ein hinterstes (15; 104; 39; 43; 54; 64; 73; 94) der in den Boden eingreifenden Elemente von dem Fußort nach hinten positioniert ist.

7. Protektionssystem nach irgendeinem der Ansprüche 1 bis 6, wobei die in den Boden eingreifenden Elemente Paare von seitlich beabstandeten Schalen (104; 42, 43; 54; 64; 72, 73; 94) oder ein einzelnes breiteres Element (37, 39) anstelle eines Paares von Schalen aufweisen.

8. Protektionssystem nach irgendeinem der Ansprüche 1 bis 7, wobei der Fußort definiert ist durch einen Aufnehmer (106; 83), der bewegbar ist, um sich an eine aufwärts schwingende Bewegung des Fußes des Benutzers um eine Halterung (108; 94) an einem vorderen Teil des Aufnehmers anzupassen.

9. Protektionssystem nach Anspruch 8, wobei der Aufnehmer eine Schicht eines flexiblen Kunststoffmaterials (106; 83) aufweist, welche ein vorderes Ende aufweist, die mit der Plattform verbunden ist, wobei die Schicht eine Größe aufweist, so dass sie unter dem Fuß des Benutzers liegt.

10. Protektionssystem nach Anspruch 8 oder 9, wobei der Aufnehmer des Weiteren eine Bindestruktur (120, 122, 124; 85) aufweist, die konfiguriert ist, um um den Fuß und Knöchel des Benutzers in Eingriff zu stehen.

11. Protektionssystem nach irgendeinem der Ansprüche 1 bis 10, wobei der Rahmen aus einem leichtgewichtigen Verbund-, Kunststoff- oder Metallmaterial hergestellt ist.

12. Protektionssystem nach irgendeinem der Ansprüche 1 bis 9, wobei der Rahmen aus einer Verbundkonstruktion ist, die eine obere Schicht (83) eines zähen Verbund- oder Kunststoffmaterials aufweist, eine untere Schicht (186, 82) eines explosionsabsorbierenden Materials und zumindest eine innere Schicht (128, 130) aus leichtgewichtigen geschäumten Kunststoff, wabenförmigem Aluminium, oder einem anderen Verbundmaterial, das leicht kollabieren und Energie absorbieren kann.

13. Protektionssystem nach irgendeinem der Ansprüche 1 bis 12, wobei der Rahmen aus einer bogenförmigen Konfiguration ist und an seinen vorderen und hinteren Enden gabelförmig ist, um Paare seitlich beabstandeter Beine

zu definieren (102, 103; 36, 38; 72, 73; 89, 90), die untere Enden aufweisen, welche die in den Boden eingreifenden Elemente tragen.

14. Protektionssystem nach irgendeinem der Ansprüche 1 bis 13, wobei die in den Boden eingreifenden Elemente teilweise leichtgewichtiges geschäumtes Kunststoffmaterial aufweisen (50b; 64b).

15. Protektionssystem nach irgendeinem der Ansprüche 1 bis 13, wobei es zumindest zwei in den Boden eingreifende Elemente gibt, die mit einer longitudinalen Beabstandung angeordnet sind, die nicht geringer ist als die Länge des Fußortes.

16. Protektionssystem nach irgendeinem der Ansprüche 1 bis 15, wobei der Rahmen konfiguriert ist, um den Fuß des Benutzers bei einer Höhe von ungefähr 10 bis 15 cm über der Bodenoberfläche zu stützen.

17. Protektionssystem nach irgendeinem der Ansprüche 1 bis 15, wobei der Rahmen konfiguriert ist, um den Fuß des Benutzers bei einer Höhe von zwischen ungefähr 15 und 30 cm über der Bodenoberfläche zu stützen.

18. Protektionssystem nach irgendeinem der Ansprüche 1 bis 17, wobei jedes der in den Boden eingreifenden Elemente (104; 94) eine abgerundete Unterseite für einen Eingriff mit der stützenden Bodenoberfläche aufweist.

19. Protektionssystem nach Anspruch 18, wobei die in den Boden eingreifenden Elemente äußere Hüllen (94) beinhalten, die einrastend daran befestigt sind, jedoch selektiv für ein Ersetzen abnehmbar sind, wobei jede Schale von einer abgerundeten Konfiguration ist und aus einem elastischen Kunststoffmaterial.

20. Protektionssystem nach Anspruch 19, wobei die Polster bzw. Schalen hergestellt sind aus einem Material ausgewählt aus Polypropylen, Polyurethan, Silikon und Gummi, und gebildet sind mit Vorsprüngen auf den äußeren Oberflächen dieser, um den Eingriff mit der stützenden Bodenoberfläche zu verbessern.

21. Protektionssystem nach Anspruch 19 oder 20, wobei die selektiv abnehmbaren Schalen der in den Boden eingreifenden Elemente am Ort durch Verriegelungsmittel (93.1) gesichert sind, um ein zufälliges Entfernen während des Betriebs zu verhindern.

22. Protektionssystem nach irgendeinem der Ansprüche 1 bis 21, wobei die in den Boden eingreifenden Elemente an den Enden von Armen (102, 103; 93) getragen werden, die an dem Rahmen an der Unterseite desselben befestigt sind, wobei jedes Bein aus einem Kunststoffmaterial hergestellt ist und einen begrenzten Grad an Elastizität aufweist, um dem System zu ermöglichen sich an Unregelmäßigkeiten in der unterstützenden Bodenoberfläche anzupassen.

23. Protektionssystem nach Anspruch 22, wobei die Beine in vorderen und hinteren Paaren angeordnet sind, wobei jedes Paar zwei Beine aufweist, die integral in einer V-Konfiguration (89, 90) gebildet sind, und abnehmbar an der Unterseite des Rahmen befestigt sind.

24. Protektionssystem nach irgendeinem der Ansprüche 1 bis 23, welches Abmessungen innerhalb der folgenden Bereiche aufweist:

- a) Gesamtlänge zwischen 30 und 80 cm;
- b) Breite zwischen 10 und 40 cm;
- c) Abstand zwischen der Vorderseite des Fußortes und einem vorderen in den Boden eingreifenden Element in dem Bereich von 5 cm bis 40 cm;
- d) ein Abstand von der Hinterseite des Fußortes zu dem hintersten in den Boden eingreifenden Element von zwischen 5 und 25 cm.

25. Protektionssystem nach Anspruch 8, oder nach irgendeinem der Ansprüche 9 bis 24, abhängig von Anspruch 8, wobei der Aufnehmer eine Knöchelunterstützung beinhaltet, die konfiguriert ist, um sich an einen begrenzten Bereich einer Schwenkbewegung im Verhältnis zum Aufnehmer anzupassen, um damit den Bereich der Fußbewegung um den Knöchel des Benutzers zu begrenzen.

Revendications

1. Un système de protection pour protéger le pied d'un utilisateur à l'encontre de mines antipersonnel et analogues, ce système comprenant :

un cadre (11 ; 101 ; 31 ; 41 ; 51 ; 61 ; 71 ; 82) configuré pour recevoir et être attaché à une chaussure d'un utilisateur pour supporter le pied en un emplacement qui est à une hauteur (H) d'au moins environ 10 cm au dessus d'une surface de sol ;

ce cadre portant des éléments de contact au sol pour procurer un support stable pour le cadre sur une surface de sol support ;

caractérisé en ce que les éléments de contact au sol (14 ; 15 ; 104 ; 37 ; 39 ; 42 ; 43 ; 54 ; 72 ; 73 ; 94) sont discrets et espacés, et **en ce que** le cadre présente une sous-face qui est éloignée vers le haut par rapport à ces éléments de contact au sol afin de laisser subsister un espace au-dessus de la surface de sol support.

2. Un système de protection selon la revendication 1, dans lequel au moins des parties (102, 103 ; 36, 38 ; 44, 45 ; 53 ; 62, 63, 66 ; 72, 73 ; 93) de ce système sont élastiquement déformables pour tenir compte des irrégularités de la surface de sol support.

3. Un système protecteur selon la revendication 1 ou 2, comprenant en outre un matériau de protection contre les déflagrations (128, 130 ; 34) recouvrant complètement la sous-face de l'emplacement du pied.

4. Un système protecteur selon l'une des revendications 1 à 3, dans lequel la sous-face du cadre est conformée aérodynamiquement (figure 4B) pour dévier les fragments et la charge d'onde de la déflagration.

5. Un système de protection selon l'une des revendications 1 à 4, dans lequel un avant extrême (14 ; 104 ; 37 ; 42 ; 54 ; 64 ; 72 ; 94) des éléments de contact au sol est situé en avant de l'emplacement du pied.

6. Un système de protection selon l'une des revendications 1 à 5, dans lequel un arrière extrême (15 ; 104 ; 39 ; 43 ; 54 ; 64 ; 73 ; 94) des éléments de contact au sol est situé à l'arrière de l'emplacement du pied.

7. Un système de protection selon l'une des revendications 1 à 6, dans lequel les éléments de contact au sol comprennent des paires de nacelles latéralement espacées (104 ; 42, 43 ; 54 ; 64 ; 72, 73 ; 94), ou un élément plus large unique (37,39) à la place d'une paire de nacelles.

8. Un système de protection selon l'une des revendications 1 à 7, dans lequel l'emplacement du pied est défini par un réceptacle (106 ; 83) qui est mobile pour tenir compte d'un mouvement de balancement vers le haut du pied de l'utilisateur autour d'une monture (108 ; 94) située en partie avant de ce récepteur.

9. Un système de protection selon la revendication 8, dans lequel le récepteur comprend une couche de matériau plastique flexible (106 ; 83) possédant une extrémité avant qui est reliée à la plateforme, cette couche étant dimensionnée pour s'étendre au-dessous du pied de l'utilisateur.

10. Un système de protection selon la revendication 8 ou 9, dans lequel le réceptacle comprend en outre une structure de fixation (120, 122, 124 ; 85) configurée pour s'engager autour du pied et de la cheville de l'utilisateur.

11. Un système de protection selon l'une des revendications 1 à 10, dans lequel le cadre est fabriqué à partir d'un matériau métallique, plastique ou composite léger.

12. Un système de protection selon l'une des revendications 1 à 9, dans lequel le cadre est de construction composite comprenant une couche supérieure (83) de matériau plastique ou composite dur, une couche inférieure (186, 82) de matériau d'absorption de la déflagration et au moins une couche intérieure (128, 130) en mousse plastique légère, en aluminium en nid d'abeille, ou autre matériau composite qui puisse s'écraser facilement et absorber de l'énergie.

13. Un système de protection selon l'une des revendications 1 à 12, dans lequel le cadre est de configuration avec une forme en voûte et présente une bifurcation à ses extrémités avant et arrière pour définir des paires de jambages latéralement espacés (102, 103 ; 36, 38 ; 72, 73 ; 89,90) possédant des extrémités inférieures qui portent les

éléments de contact au sol.

14. Un système de protection selon l'une des revendications 1 à 13, dans lequel les éléments de contact au sol comprennent un matériau en mousse de plastique légère (50b ; 64b) en partie.

15. Un système de protection selon l'une des revendications 1 à 13, dans lequel il y a au moins deux des éléments de contact au sol qui sont configurés avec un espacement longitudinal qui n'est pas inférieur à la longueur de l'emplacement du pied.

16. Un système de protection selon l'une des revendications 1 à 15, dans lequel le cadre est configuré pour supporter le pied de l'utilisateur à une hauteur d'environ 10 à 15 cm au-dessus de la surface de sol.

17. Un système de protection selon l'une des revendications 1 à 15, dans lequel le cadre est configuré pour supporter le pied de l'utilisateur à une hauteur comprise entre environ 15 et 30 cm au-dessus de la surface de sol.

18. Un système de protection selon l'une des revendications 1 à 17, dans lequel chacun des éléments de contact au sol (104 ; 94) possède une sous-face arrondie pour venir en contact avec la surface de sol support.

19. Un système de protection selon la revendication 18, dans lequel les éléments de contact au sol comprennent des coquilles externes (94) qui y sont fixés à verrouillage, mais sélectivement amovibles pour le remplacement, chacune de ces coquilles étant de configuration arrondie et en un matériau plastique élastique.

20. Un système de protection selon la revendication 19, dans lequel les tampons sont fabriqués à partir d'un matériau choisi parmi le polypropylène, le polyuréthane, le silicone et le caoutchouc, et sont formés avec des saillies sur leurs surfaces extérieures pour améliorer le contact avec la surface de sol support.

21. Un système de protection selon la revendication 19 ou 20, dans lequel les coquilles sélectivement amovibles des éléments de contact au sol sont fixées en place par des moyens de verrouillage (93.1) pour empêcher un retrait accidentel en cours d'utilisation.

22. Un système de protection selon l'une des revendications 1 à 21, dans lequel les éléments de contact au sol sont portés aux extrémités de bras (102, 103 ; 93) qui sont reliés au cadre à la sous-face de celui-ci, chacun des jambages étant fabriqué en un matériau plastique et ayant un degré limité d'élasticité pour permettre au système de s'adapter aux irrégularités de la surface de sol support.

23. Un système de protection selon la revendication 22, dans lequel les jambages sont disposés par paires avant et arrière, chaque paire ayant deux jambages qui sont formés monoblocs avec une configuration en V (89, 90) et sont fixés de manière libérable à la sous-face du cadre.

24. Un système de protection selon l'une des revendications 1 à 23, présentant des dimensions comprises dans les plages suivantes :

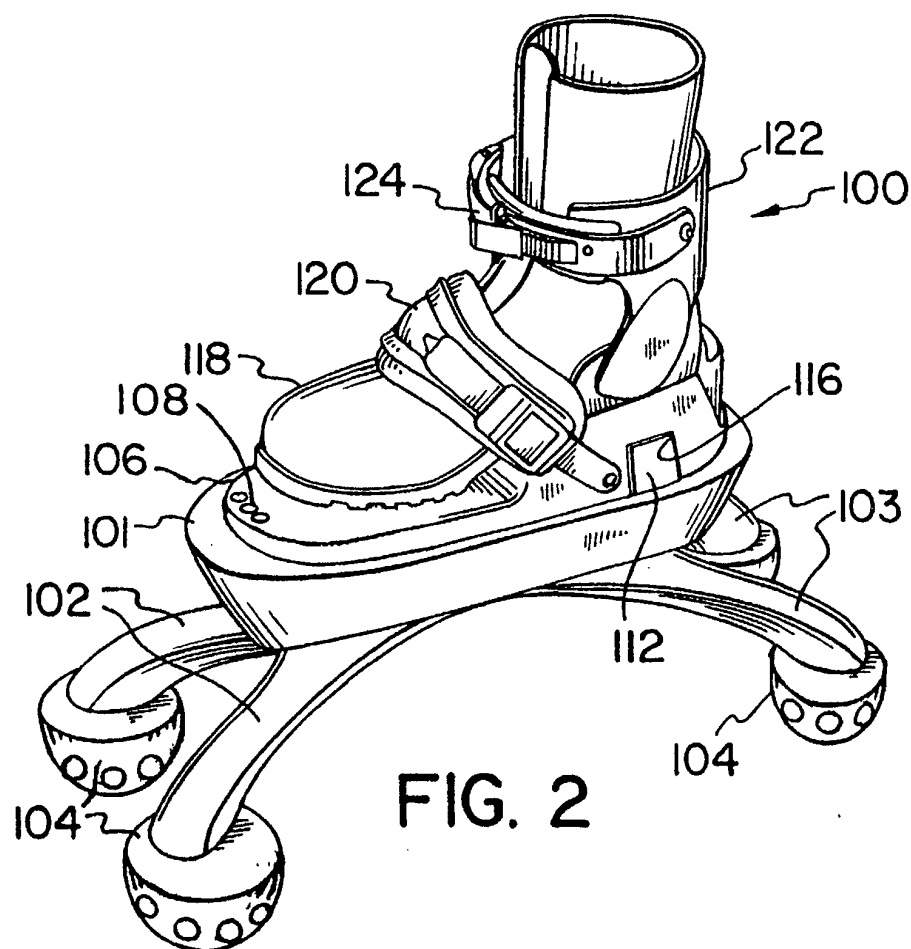
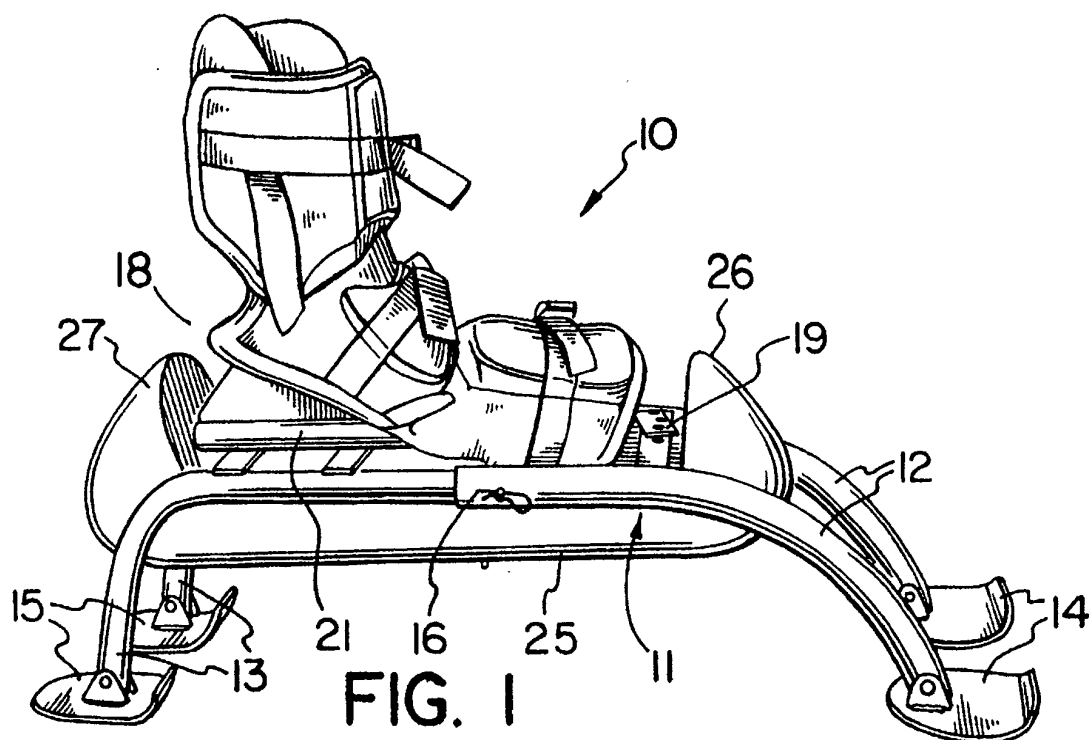
a) longueur total entre 30 et 80 cm ;

b) largeur entre 10 et 40 cm ;

c) distance entre l'avant de l'emplacement du pied et un élément de contact au sol avant dans la plage allant de 5 cm à 40 cm ;

d) une distance de l'arrière de l'emplacement du pied à l'élément de contact au sol le plus en arrière entre 5 et 25 cm.

25. Un système de protection selon la revendication 8 ou selon l'une des revendications 9 à 24 prise en dépendance de la revendication 8, dans lequel le réceptacle comprend un support de cheville qui est configuré pour s'adapter à une amplitude limitée de mouvement de pivotement par rapport au récepteur, délimitant ainsi l'amplitude du mouvement du pied autour de la cheville de l'utilisateur.



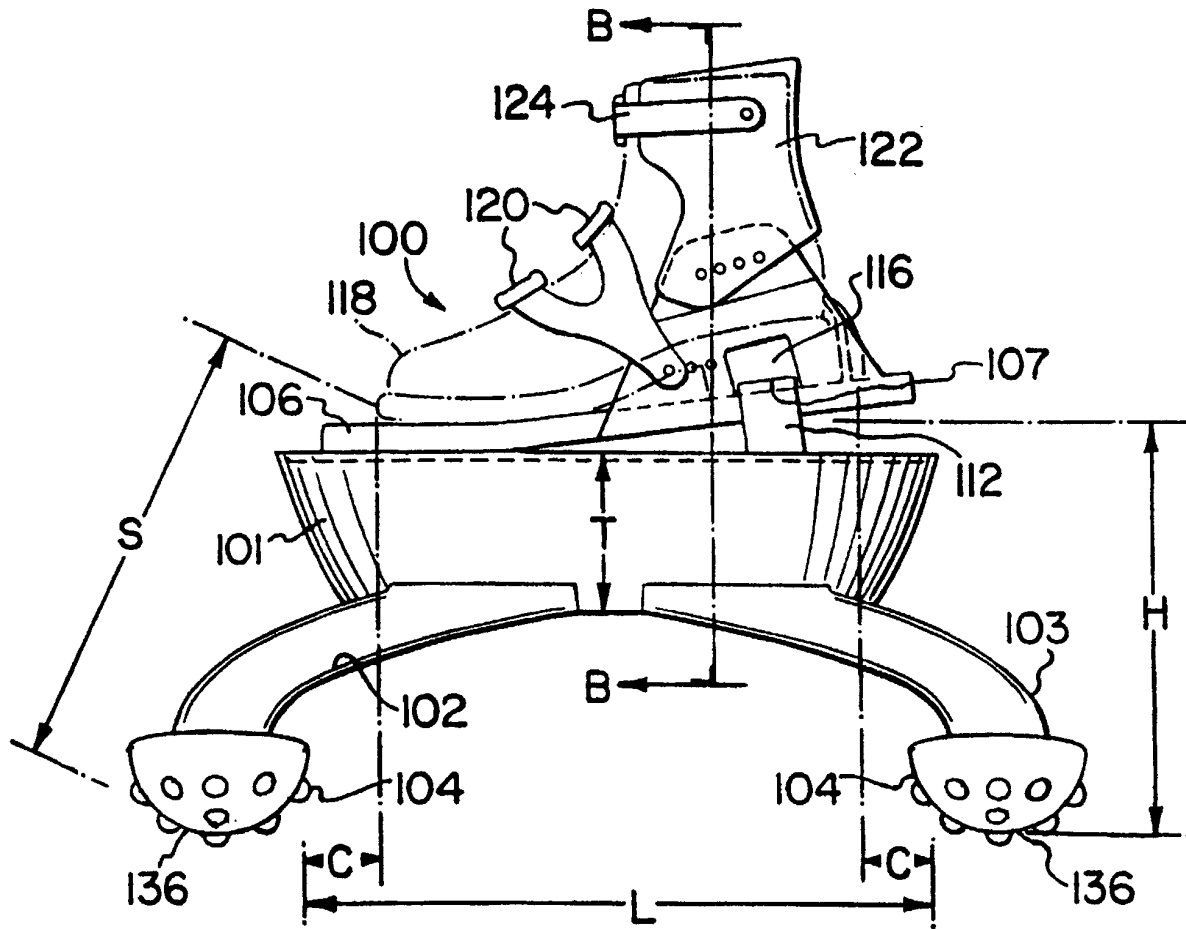


FIG. 3

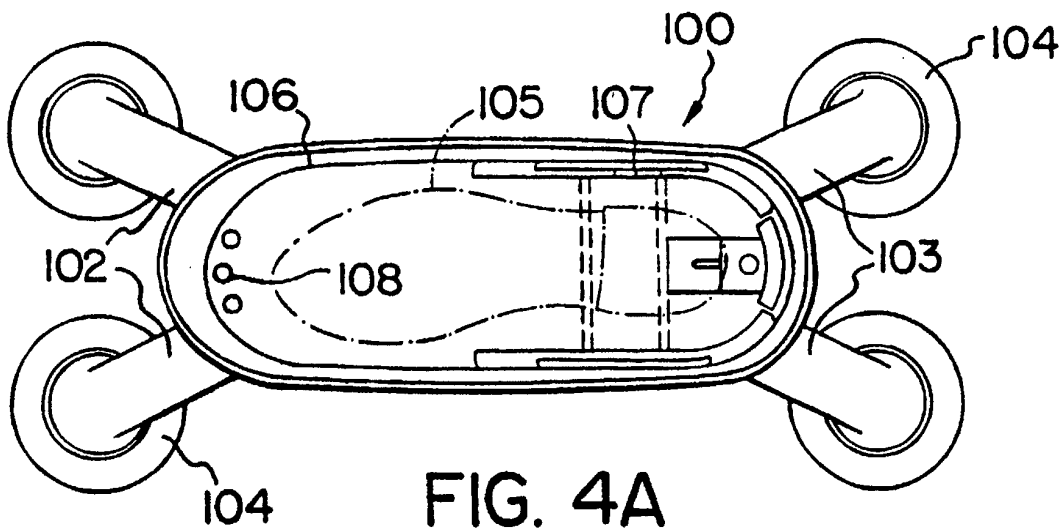
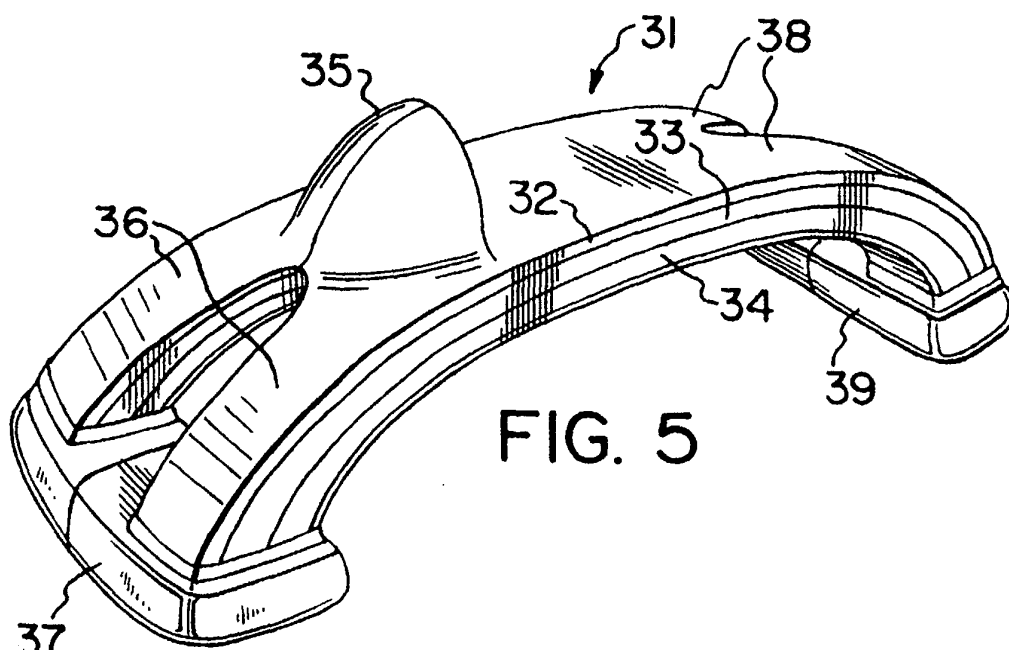
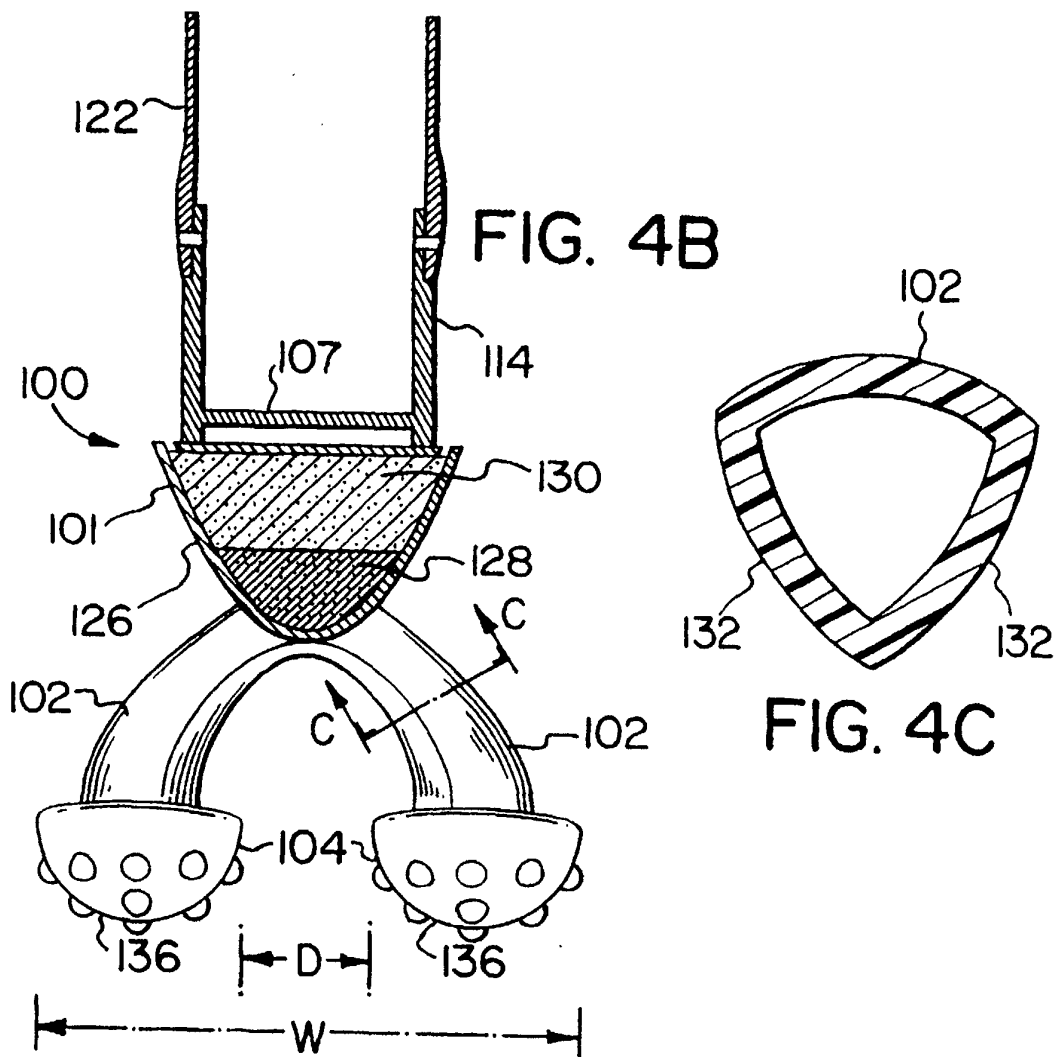
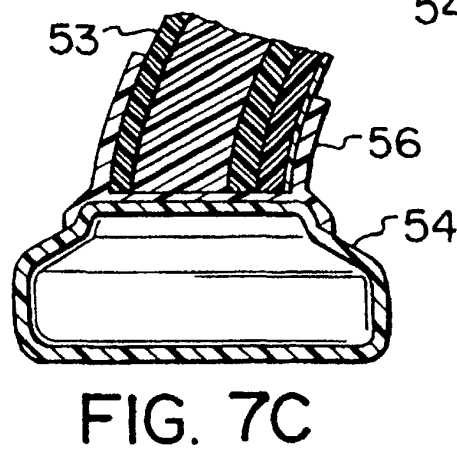
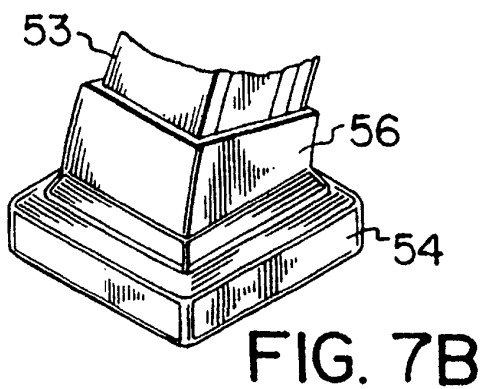
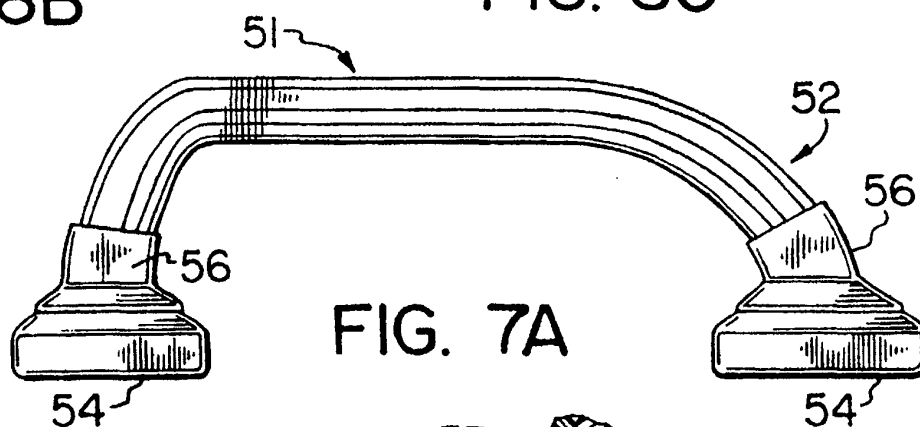
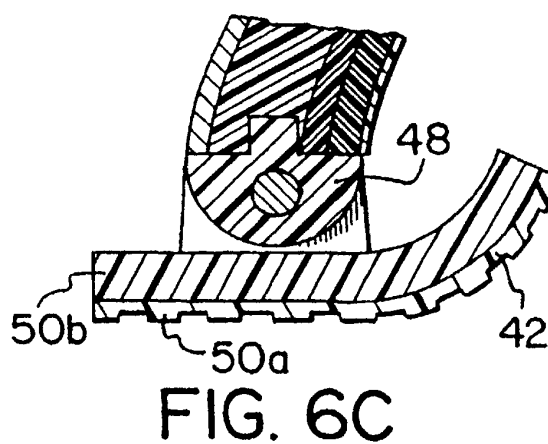
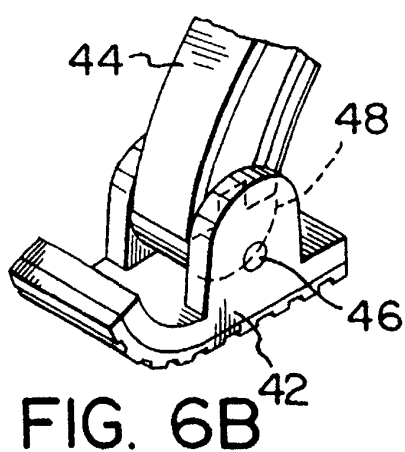
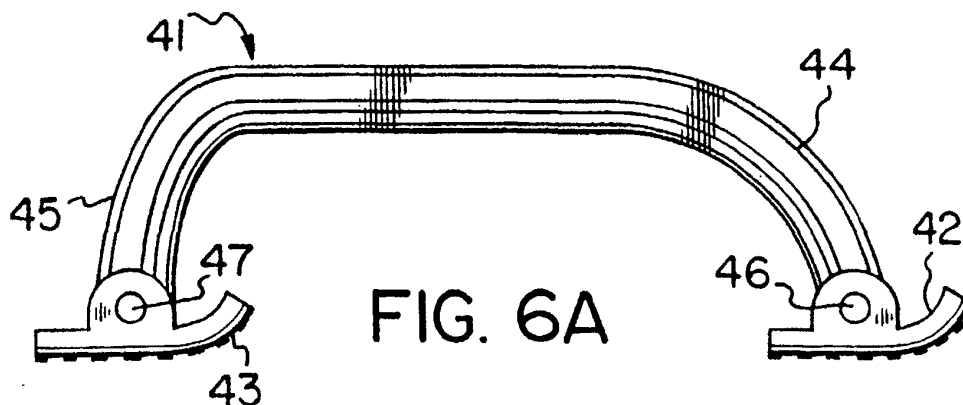
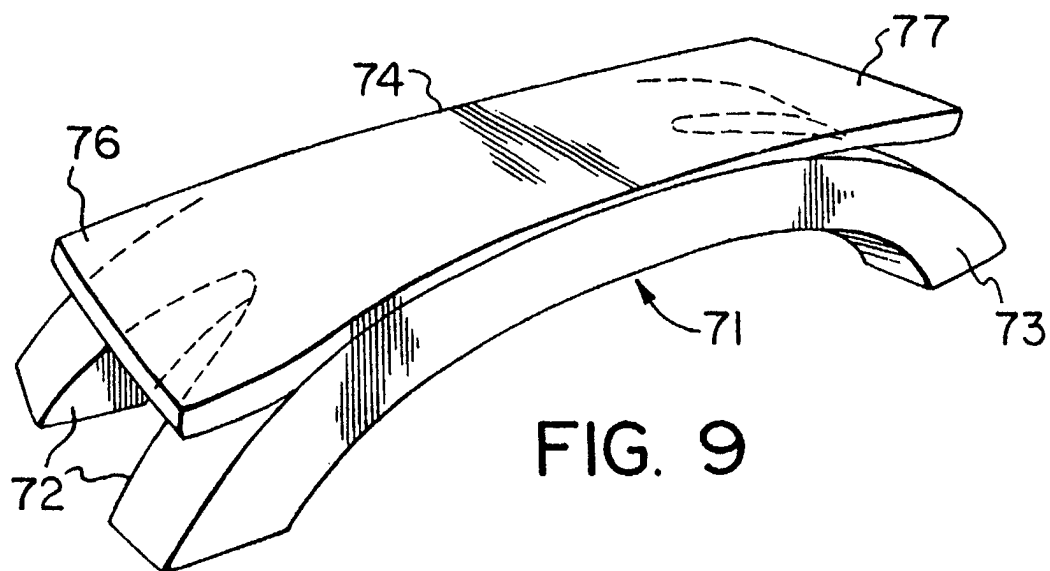
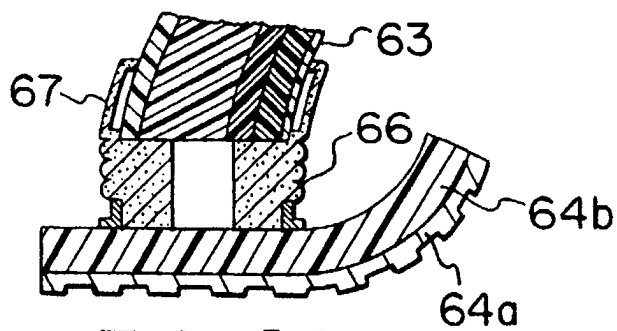
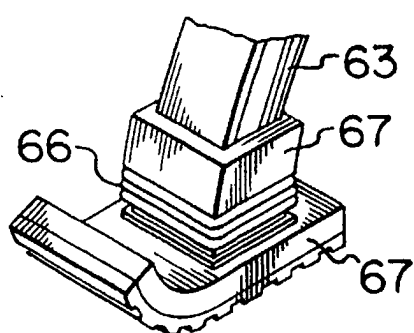
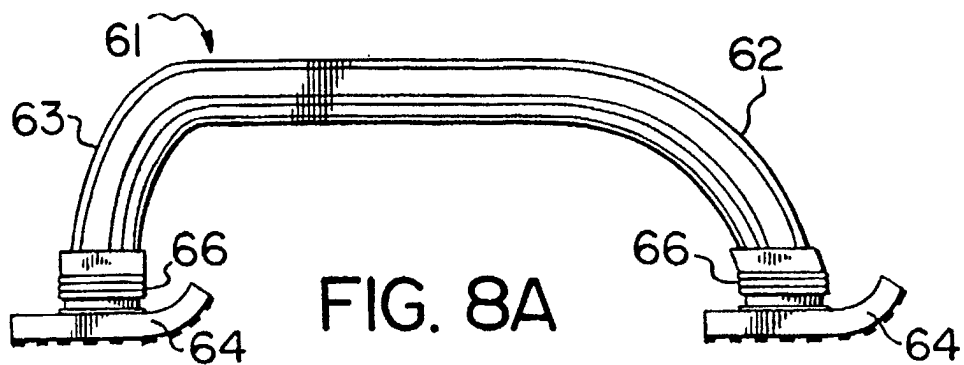


FIG. 4A







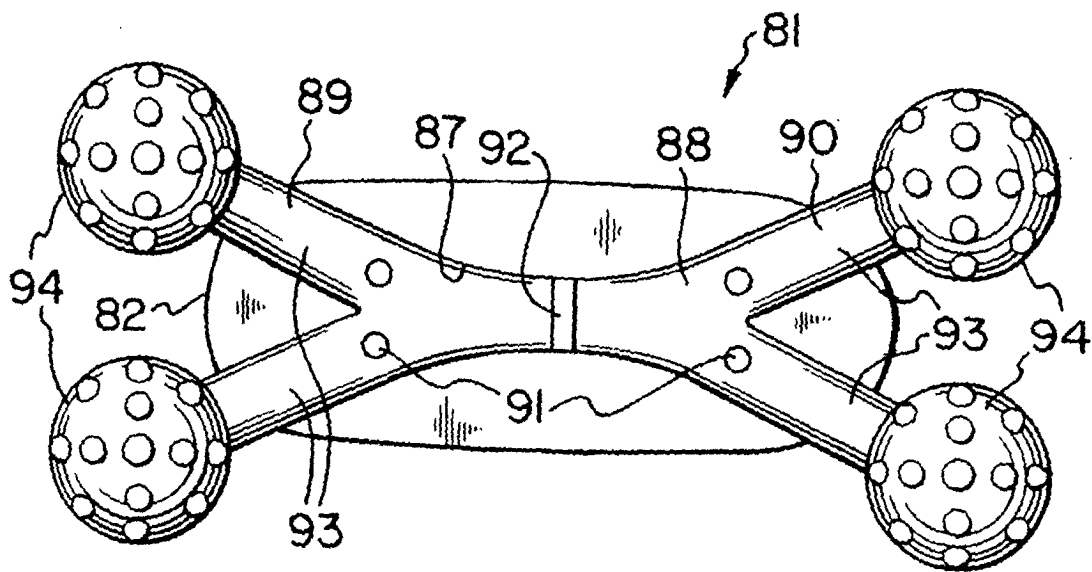


FIG. 11

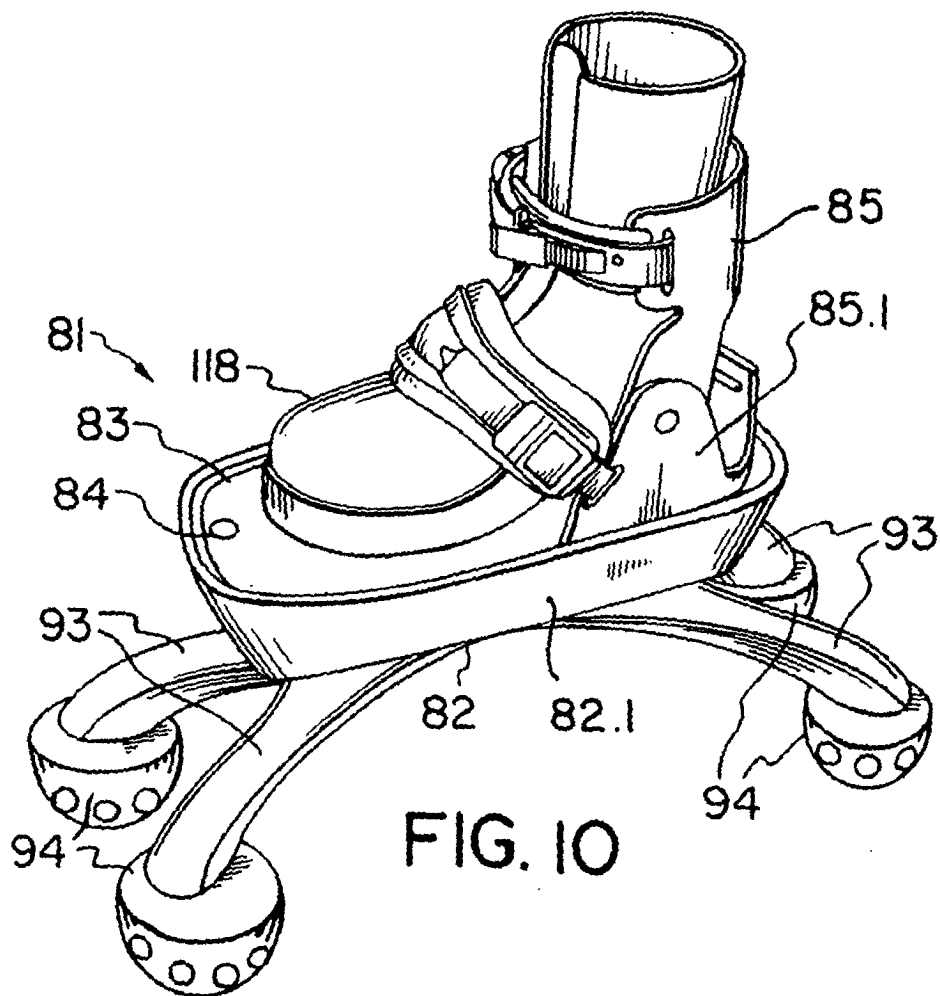
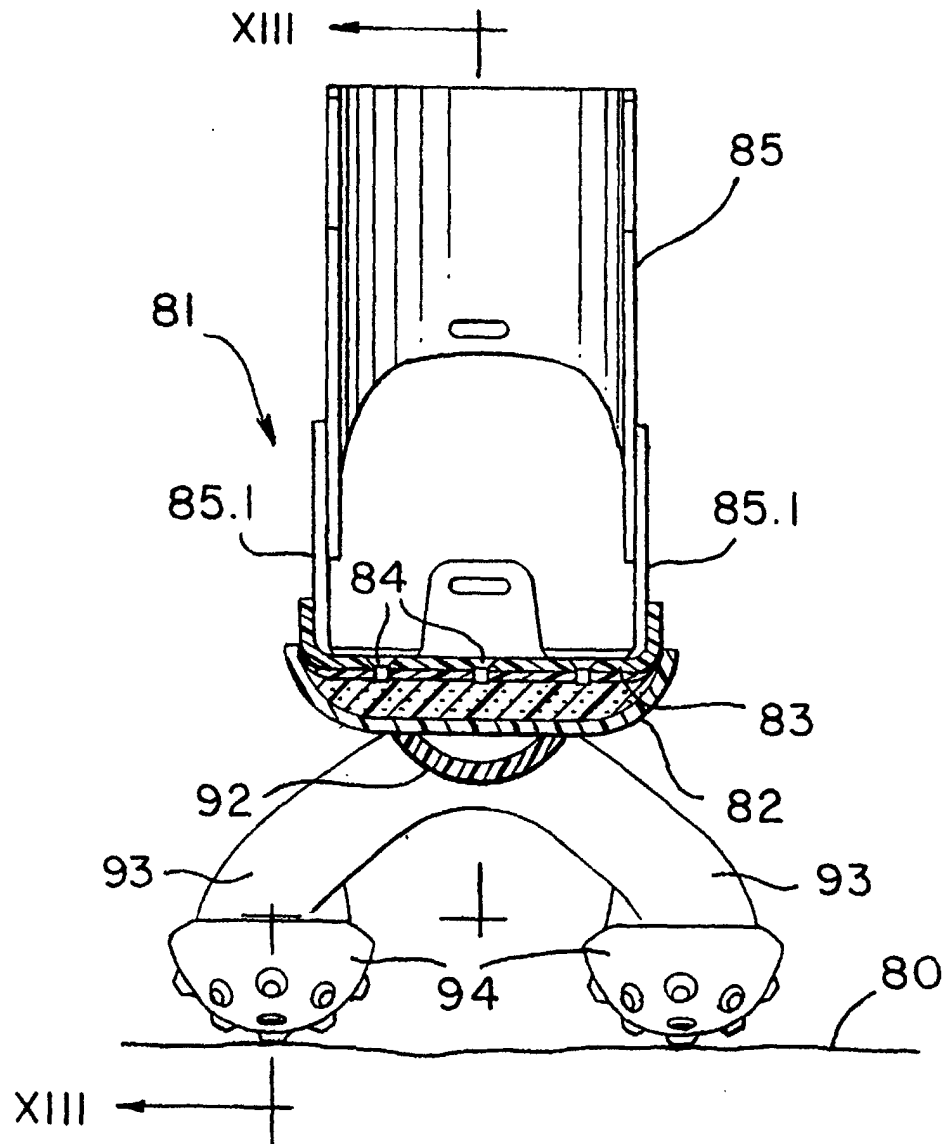
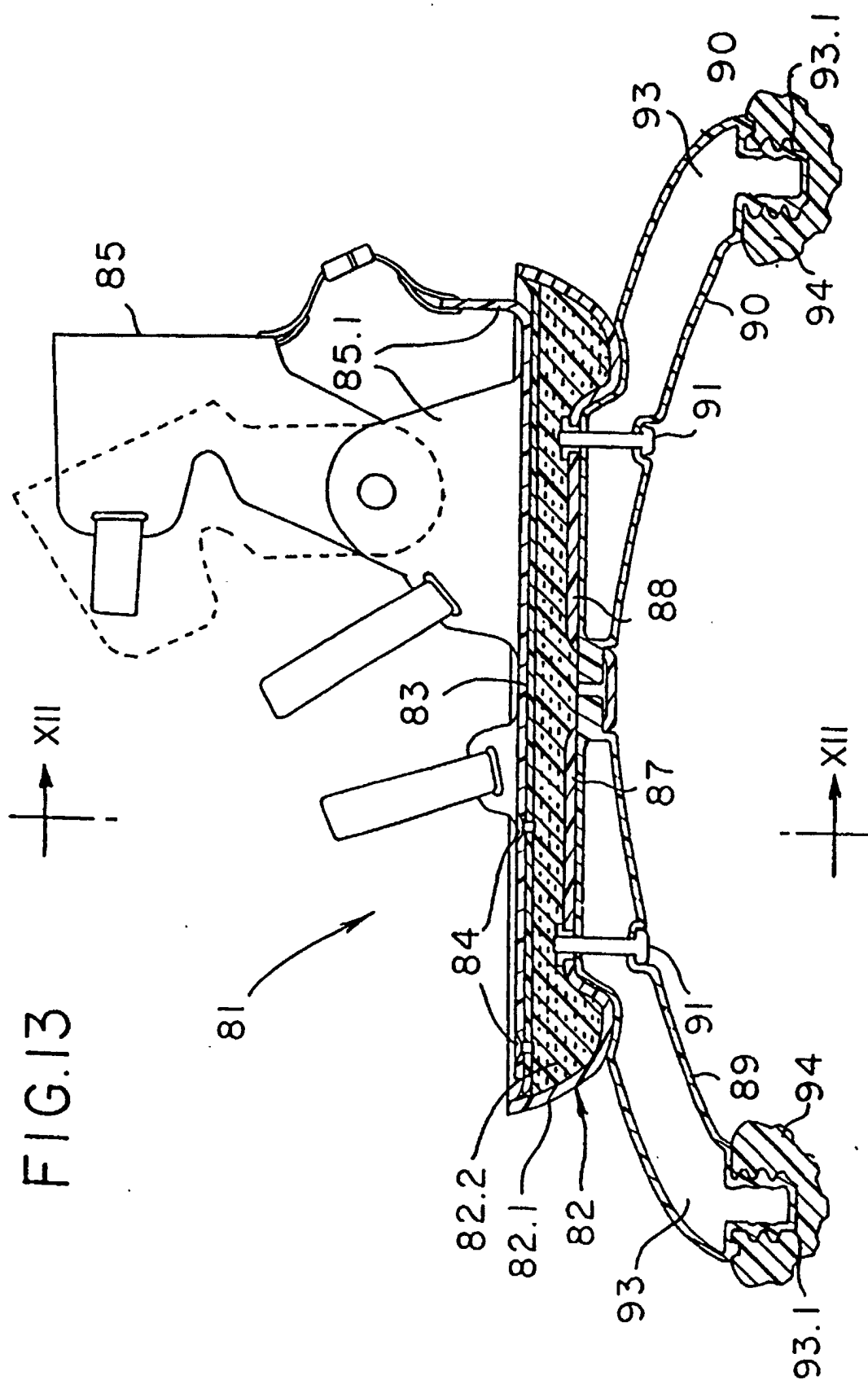


FIG. 10

FIG. 12





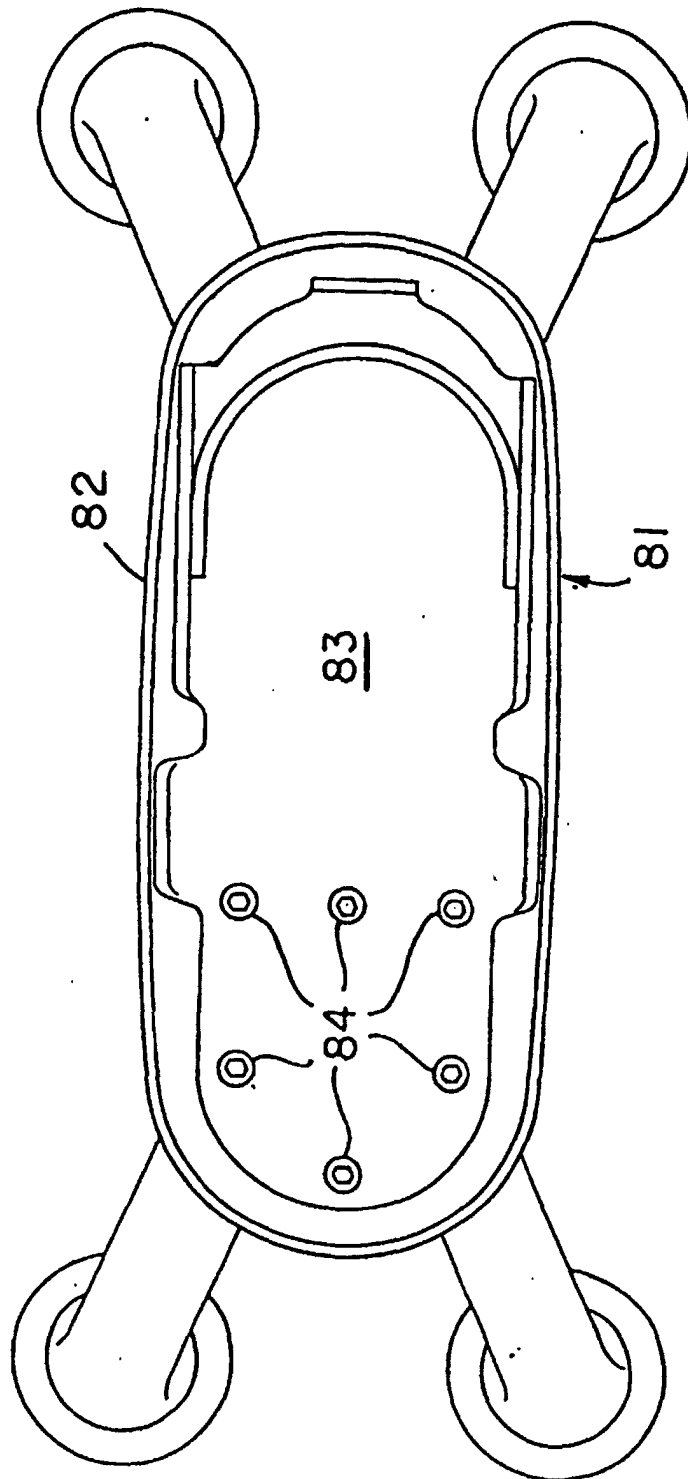


FIG. 14