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(54) Title: ANKLE SUPPORTS

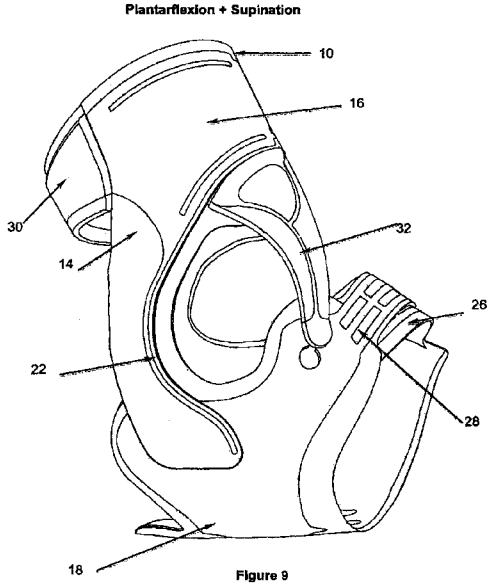


Figure 9

(57) Abstract: An ankle support having a leg portion connected sidewardly and rearwardly to a foot portion by at least one elongate resilient C-shaped member extending vertically on at least one medial or lateral side of an Achilles tendon of a wearer, wherein the at least one C-shaped member opens forwardly around at least one medial or lateral malleoli of the wearer, and wherein the at least one C-shaped member is constructed and arranged to allow natural functional ankle movement in both dorsiflexion and plantar flexion with minimal impedance while controllably inhibiting rolling ankle movement in inversion or eversion.

ANKLE SUPPORTS

Field

[0001] The present invention relates to ankle supports (or braces) for sports, work and recreational activities.

Background

[0002] Ankle braces and adhesive sports tape are commonly used to provide ankle support and prevent or minimise ankle ligament injuries in sports, work and recreational activities.

[0003] Conventional hinged or wrap ankle braces typically provide static lateral stability but hinder dynamic sports performance by unduly restricting natural range of ankle motion.

[0004] Adhesive sports tape typically provides proprioception (or perception of support) but is difficult to apply, not reusable, loosens due to perspiration and causes skin irritation.

[0005] A need therefore exists for ankle supports that address or alleviate at least some of the problems described above.

Summary

[0006] According to the present invention, there is provided an ankle support having a leg portion connected sidewardly and rearwardly to a foot portion by at least one elongate resilient C-shaped member extending vertically on at least one medial or lateral side of an Achilles tendon of a wearer, wherein the at least one C-shaped member opens forwardly around at least one medial or lateral malleoli of the wearer, and wherein the at least one C-shaped member is constructed and arranged to allow natural functional ankle movement in both dorsiflexion and plantar flexion with minimal impedance while controllably inhibiting rolling ankle movement in inversion or eversion.

[0007] The leg portion may be connected sidewardly and forwardly to the foot portion by at least one resilient stay.

[0008] The ankle support may have medial and lateral sides, wherein both the at least one C-shaped member and the at least one resilient stay are provided on the lateral side of the ankle support.

[0009] The leg portion, foot portion and at least one C-shaped member may form a skeleton of resilient, semi-rigid material.

[0010] The skeleton may be at least partially surrounded by a skin of conformable, flexible material.

[0011] The at least one resilient stay may be removably connectable between the leg portion and the foot portion.

[0012] The at least one resilient stay may include a spine of resilient, semi-rigid material.

[0013] The spine may be at least partially surrounded by a skin of conformable, flexible material.

[0014] The spine may be generally Y-shaped or generally X-shaped with a plurality of branch members, wherein at least one branch member is sacrificial by being adapted to break before other branch members.

[0015] The present invention also provides an article of footwear including an ankle support described above.

Brief Description of Drawings

[0016] Embodiments of the invention will now be described by way of example only with reference to the accompanying drawing, in which:

Figure 1 is a front perspective view of a skeleton of an ankle support having medial and lateral C-shaped members according to one embodiment of the present invention;

Figure 2 is a front perspective view of a skin for the skeleton of Figure 1;

Figure 3 is a front perspective view of the ankle support;

Figure 4 is a lateral side view of the ankle support;

Figure 5 is a front view of a resilient stay of the ankle support;

Figure 6 is a rear perspective view of the resilient stay;

Figure 7 is a rear view of the ankle support in a neutral position;

Figure 8 is a rear view of the ankle support in supination (or inversion);

Figure 9 is a lateral side view of the ankle support in supination and plantarflexion;

Figure 10 is a lateral side view of the ankle support in dorsiflexion;

Figures 11 to 13 are front views of mutually different configurations of the resilient stay;

Figures 14 and 15 are front views of the resilient stay in dorsiflexion and plantarflexion respectively;

Figure 16 is a rear view of an ankle support having a lateral C-shaped member according to another embodiment of the present invention;

Figure 17 is a side view of the ankle support integrated with a footwear insole;

Figure 18 is a side view of the ankle support integrated with a bootie insert for a boot;

Figure 19 is a side view of the ankle support integrated into a sports shoe;

Figure 20 is a front perspective view of a further embodiment of the ankle support having a figure-of-eight shaped attachment strap;

Figures 21 to 27 are front and rear perspective views another embodiment of the ankle support having an X-shaped resilient stay in the neutral position, and during supination, plantarflexion, dorsiflexion, and combinations thereof.

Figures 28 to 31 are front views of the X-shaped resilient stay in the neutral position, and during compression (dorsiflexion), extension (plantarflexion), and supination; and

Figure 32 is a rear view of the ankle support of Figures 21 to 27.

Description of Embodiments

[0017] Figures 1 to 4 illustrate an ankle support 10 according to a first embodiment of the present invention. Referring to Figures 1 and 2, the ankle support 10 generally includes a skeleton 12 of a resilient, semi-rigid material, such as glass reinforced polypropylene, and a skin 14 of conformable, flexible material, such as thermoplastic polyester elastomer. The skin 14 conforms and passively adheres to the skin of a wearer to provide increased proprioceptive stimuli, feedback and awareness to a wearer in similar fashion to conventional adhesive sports tape. Other equivalent materials may also be used. The skeleton 12 includes a leg portion 16 connected sidewardly and rearwardly to a foot portion 18 by lateral (outside) and medial (inside) forwardly opening elongate resilient C-shaped members 20, 22. The C-shaped members 20, 22 are generally, substantially or at least partially C-shaped. Other equivalent configurations of C-shaped members or C-springs may also be used. The leg portion 16 is, for example, shaped and dimensioned as a rearwardly and/or forwardly opening cuff adapted to fit around a lower leg and allow rear and/or front insertion of the leg into the leg portion 16. The leg portion 16 is optionally formed by opposing complementary upper portions of the C-shaped members 20, 22 so that the leg

portion 16 has both front and/or rear access via front and/or rear openings. For example, Figure 32 illustrates an embodiment of the ankle support 10 having a leg portion 16 with rear access provided by a closable rear opening. The foot portion 18 is, for example, shaped and dimensioned to surround a heel of a foot, and extend across the foot arch forwardly of the heel and rearwardly of the fifth metatarsal. The foot portion 18 is, for example, generally, substantially, or at least partially U-shaped in cross section. Referring to Figure 18, the foot portion 18 optionally includes a heel lock portion 35 that extends up and around a wearer's heel to positively and lockingly engage the heel of the foot. Other equivalent configurations of the leg portion 16 and the foot portion 18 may also be used. The leg portion 16 and the foot portion 18 are respectively adjustably attachable to the lower leg and foot via integral or removable straps 24, 26, 28 (shown in partially broken away form in Figures 1 and 2 for sake of clarity). The straps 24, 26, 28 are removably fastenable to the leg portion 16, foot portion 18 and one another by releasable fasteners, such as hook-and-loop strips, and structural anchor slots and loops. Other equivalent strap and fastening configurations may also be used.

[0018] Referring to Figures 3 and 4, the skin 14 is formed over inner and outer surfaces, and around peripheral edges, of the skeleton 12 by over-moulding or co-moulding to form the complete ankle support 10. Other equivalent composite or integral construction techniques may also be used. Referring to Figure 7, the leg portion 16 includes a spacer 30 optional formed as part of the skin 14. The C-shaped members 20, 22 are positionable on opposite medial and lateral sides of the Achilles tendon, and the spacer 30 is positionable above the Achilles tendon. The C-shaped members 20, 22 are constructed and arranged to allow natural functional ankle movement in both dorsiflexion and plantar flexion with minimal impedance while inhibiting rolling ankle movement in inversion. In other words, the shape and configuration of the C-shaped members 20, 22 are selected to controllably deform elastically in all three planes of motion of the ankle and foot (frontal, sagittal and horizontal) to allow natural functional ankle movement in plantarflexion (sagittal plane) while controllably limiting rolling ankle movement in inversion (frontal plane) and adduction (horizontal plane). The C-shaped members 20, 22 therefore provide ankle support and inhibit ankle injury by controlling supination of the foot. Supinantion is a tri-planar motion that involves inversion, adduction and plantar flexion of the foot and ankle. Although primarily concerned with preventing inversion which is the most common form of ankle injury, the ankle support 10 optionally further or alternatively provides controlled ankle movement in eversion.

[0019] To further inhibit, prevent or minimise inversion (or supination) sprains of the ankle (not shown), the leg portion 16 is connected sidewardly and forwardly to the foot portion 18

on the lateral (or outer) side of the ankle support 10 by an elongate resilient stay 32. The resilient stay 32 is removably connectable between the leg portion 16 and the foot portion 18, for example, by integral press-fit, friction-fit, slide-fit, or keyhole connectors. Although not shown, the ankle support 10 optionally further or alternatively includes a resilient stay 32 on the medial (or inner) side to prevent or minimise eversion of the ankle.

[0020] Referring to Figures 5 and 6, the resilient stay 32 includes a generally Y-shaped spine 38 of resilient, semi-rigid material, such as such as glass reinforced polypropylene, and a skin 40 of conformable, flexible material, such as thermoplastic polyester elastomer. Other equivalent materials may also be used. The Y-shaped spine 38 includes a central curved member having one sacrificial branch member adapted to break before the central curved member. Figure 13 illustrates a trident-shaped resilient stay 32 having two sacrificial branch members adapted to break before the central curved member. The upper end of the spine 38 is provided with tabs 44 that press fit into complementary slots formed in a lower front edge of the leg portion 16. The lower end of the spine 38 is provided with a mushroom head 42 that is pivotally received in a complementary keyhole slot formed in an upper front edge of the foot portion 18.

[0021] Referring to Figures 8 to 10, the medial and lateral C-shaped members 20, 22 and the lateral resilient stay 32 flex, twist and compress to allow natural range of ankle motion in plantar flexion, dorsiflexion and eversion while resiliently controlling and resisting potentially injurious range of motion in inversion. Figures 14 and 15 respectively illustrate compression and tension of the resilient stay 32 during dorsiflexion and plantarflexion. The central curved member of the spine 38 opens rearwardly to bias the resilient stay 32 towards compression during dorsiflexion. During plantarflexion, the central curved member of the spine 38 straightens and elongates under tension.

[0022] Referring to Figures 11 to 13, a plurality of mutually different resilient stays 32 are optionally interchangeable to provide different levels of inversion resistance. For example, Figures 11 and 12 respectively illustrate resilient stays 32 having long and short spines 38, wherein the short spine 38 provides greater inversion resistance relative to the long spine 38. The degree of inversion resistance provided by different resilient stays 32 is optionally varied by selecting mechanical properties of materials of the spine 38 and skin 40 to provide different tensile strengths, durometers, elasticities and resiliencies. Further or alternatively, the cross section area and shape of the spine 38 are selectively varied to provide resilient stays 32 with mutually different rigidities, resiliencies, tensile strengths and elasticities for

different degrees of inversion resistance. The mechanical properties of the C-shaped members 20, 22 are optionally selectively varied in a similar fashion.

[0023] Referring to Figure 16, a second embodiment of the ankle support 10 omits the medial C-shaped member 20 so that ankle support and inversion resistance is provided by the lateral C-shaped member 22 and lateral resilient stay 32. Other equivalent combinations of lateral and/or medial C-shaped members, and lateral and/or medial resilient stays, may also be used.

[0024] The thicknesses of the skeleton 12 and the skin 14 are selected so that the ankle support 10 is sufficiently low profile to be removably received, or wholly or partially integrated internally or externally, in an article of footwear. The ankle support 10 can therefore be worn inside or outside a sock inside a normal shoe or boot. For example, Figure 17 illustrates the ankle support 10 integrated in with a footwear insole 36. Figure 18 illustrates the ankle support 10 integrated with a bootie insert 34 for a boot, such as motocross boot (not shown). Figure 19 illustrates the ankle support 10 integrated into articles of sports footwear, such as running shoes, football boots, basketball shoes, etc. Further or alternatively, the ankle support 10 is optionally integrated in work footwear, such as work boots, to enhance occupational health and safety by reducing workplace ankle inversion injuries.

[0025] Figures 20 illustrates a further embodiment of the ankle support 10 in which attachment straps 24, 25, 26 are integrated into a generally X-shaped, cross-over, wrap-around, or figure-of-eight shaped strap 24, 25, 26. The figure-of-eight shaped strap 24, 25, 26 extends under and around the foot portion 18, crosses over itself in front of the leg and above the foot, and then wraps around to close the leg portion 16. The figure-of-eight shaped strap 24, 25, 26 is optionally at least partially resilient and self-fastenable onto itself, for example, by releasable fasteners, such as low-profile or micro hook-and-loop or touch strip fasteners. This strap arrangement allows the ankle support 10 to be securely and comfortably self-applied, fitted and adjusted by a wearer without prior strapping or taping knowledge or skills so that they feel 'strapped up' or 'taped up'. In addition, this strap arrangement provides a 'tape-like' feel that increases proprioceptive stimuli to prevent injurious ankle movement in inversion by giving proprioceptive information and feedback to the wearer of imminent onset of movement in inversion.

[0026] Figures 21 to 32 illustrate further embodiments of the ankle support 10 in which the resilient stay 32 is generally X-shaped. The lower branches of the X-shaped resilient stay

32 extend under and around the foot portion 18. The end portions of the lower branches of the X-shaped resilient stay 32 are releasably fastenable to the foot portion 18 via hook-and-loop fasteners, such as low profile hook-and-loop fasteners. Referring to Figure 22, the upper branches of the X-shaped resilient stay 32 are optionally removably connectable to front portions of the leg portion 16 via keyhole fasteners. As illustrated in Figures 23 to 27 and 32, the upper branches of the X-shaped resilient stay 32 extend beyond the keyhole fasteners to wrap around and close the leg portion 16. In these embodiments, the extended end portions of the upper branches of the X-shaped resilient stay 32 are releasably fastenable to the leg portion 16 via hook-and-loop fasteners, such as low profile hook-and-loop fasteners.

[0027] Referring to Figures 28 to 31, the X-shaped resilient stay 32 has a generally similar construction to the elongate resilient stay 32 described above. The X-shaped resilient stay 32 includes a generally X-shaped spine 38 of resilient, semi-rigid material, such as such as glass reinforced polypropylene, and a skin 40 of conformable, flexible material, such as thermoplastic polyester elastomer. One or more upper and lower branches on medial and laterals sides of the X-shaped spine 38 are sacrificial and adapted to break during inversion movement in injurious ranges. The X-shaped spine 38 includes a central triangular cut out that facilitates controlled range and rate of movement of the upper and lower branches during tri-planar supination motion that involves inversion, adduction and plantar flexion of the foot and ankle. Figures 28 to 31 respectively illustrate neutral positioning, compression, tensioning, and lateral bending of the X-shaped resilient stay 32 in the neutral position, and during complex tri-planar movement involving dorsiflexion, plantarflexion, and supination of the ankle and foot. [0028] Embodiments of the ankle support of the present invention provide a useful alternative to ankle braces and adhesive sports tape. Embodiments of the invention provide hingeless ankle supports or braces that inhibit injurious inversion of the ankle and increase proprioceptive awareness of ankle support, position and movement. In addition, embodiments of the invention allow, and minimally impede, natural functional ankle movement in plantarflexion and dorsiflexion. Embodiments of the ankle support can be self-applied without prior specialist knowledge, and can be worn inside or outside socks in conventional footwear.

[0029] The embodiments have been described by way of example only and modifications are possible within the scope of the claims that follow.

Claims

1. An ankle support having a leg portion connected sidewardly and rearwardly to a foot portion by at least one elongate resilient C-shaped member extending vertically on at least one medial or lateral side of an Achilles tendon of a wearer, wherein the at least one C-shaped member opens forwardly around at least one medial or lateral malleoli of the wearer, and wherein the at least one C-shaped member is constructed and arranged to allow natural functional ankle movement in both dorsiflexion and plantar flexion with minimal impedance while controllably inhibiting rolling ankle movement in inversion or eversion.

2. An ankle support according to claim 1, wherein the leg portion is connected sidewardly and forwardly to the foot portion by at least one resilient stay.

3. An ankle support according to claim 2, wherein the ankle support has medial and lateral sides, and wherein both the at least one C-shaped member and the at least one resilient stay are provided on the lateral side of the ankle support.

4. An ankle support according to any preceding claim, wherein the leg portion, foot portion and at least one C-shaped member form a skeleton of resilient, semi-rigid material.

5. An ankle support according to claim 4, wherein the skeleton is at least partially surrounded by a skin of conformable, flexible material.

6. An ankle support according to any one of claims 2 to 5, wherein the at least one resilient stay is removably connectable between the leg portion and the foot portion.

7. An ankle support according to any one of claims 2 or 6, wherein the at least one resilient stay includes a spine of resilient, semi-rigid material.

8. An ankle support according to claim 7, wherein the spine is at least partially surrounded by a skin of conformable, flexible material.

9. An ankle support according to claim 7 or 8, wherein the spine is generally Y-shaped or generally X-shaped with a plurality of branch members, and wherein at least one branch member is sacrificial by being adapted to break before other branch members.

10. An article of footwear including an ankle support according to any preceding claim.

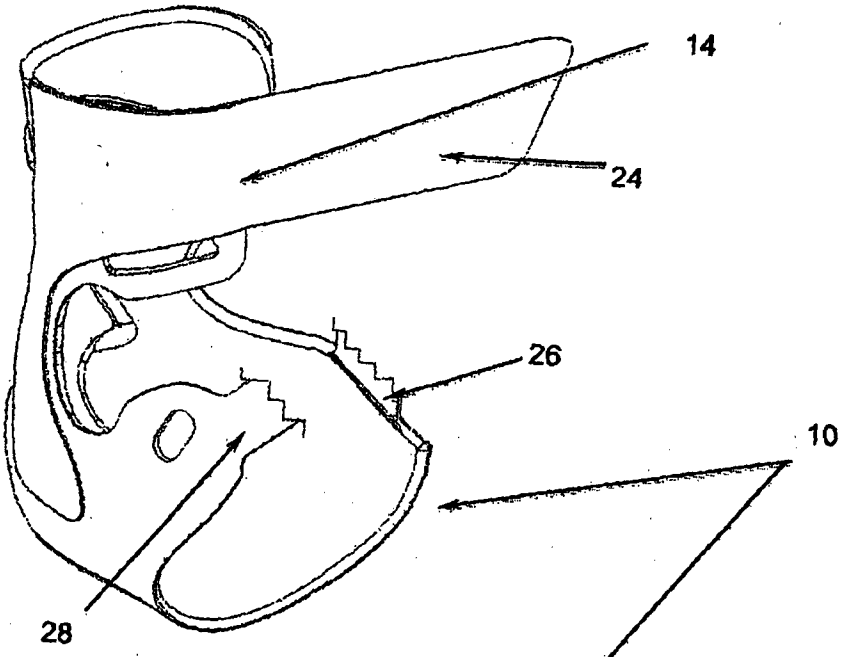


Figure 2

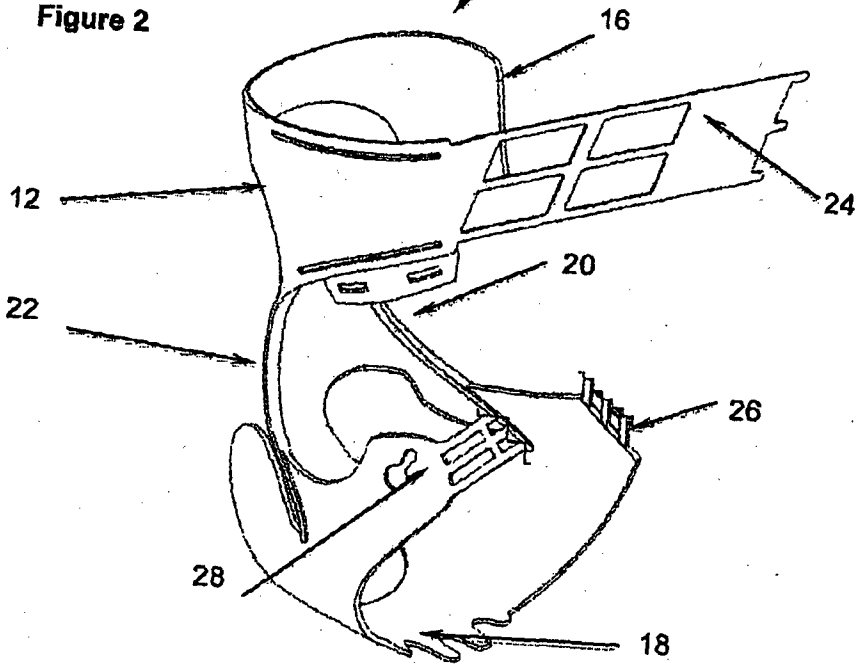


Figure 1

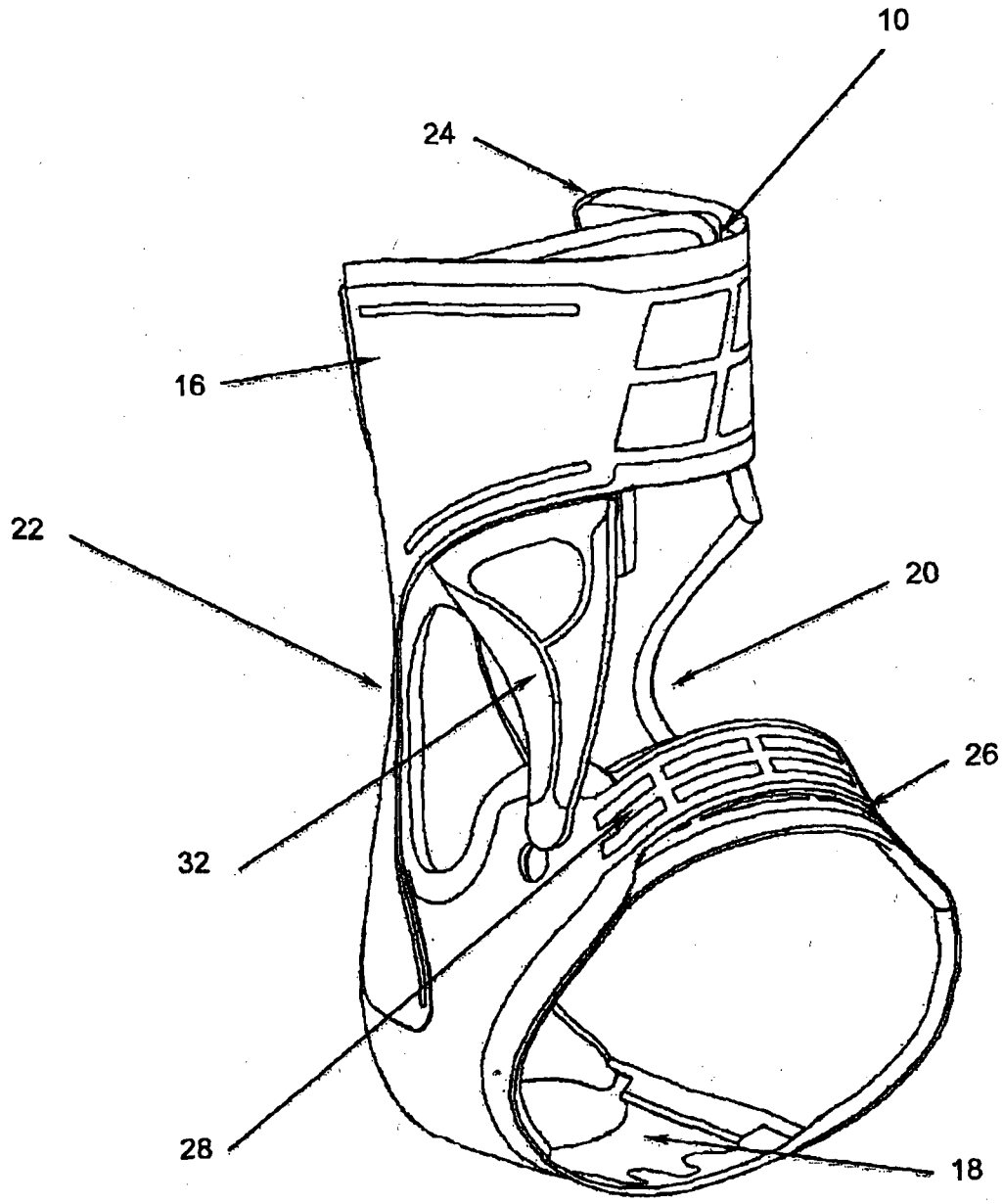


Figure 3

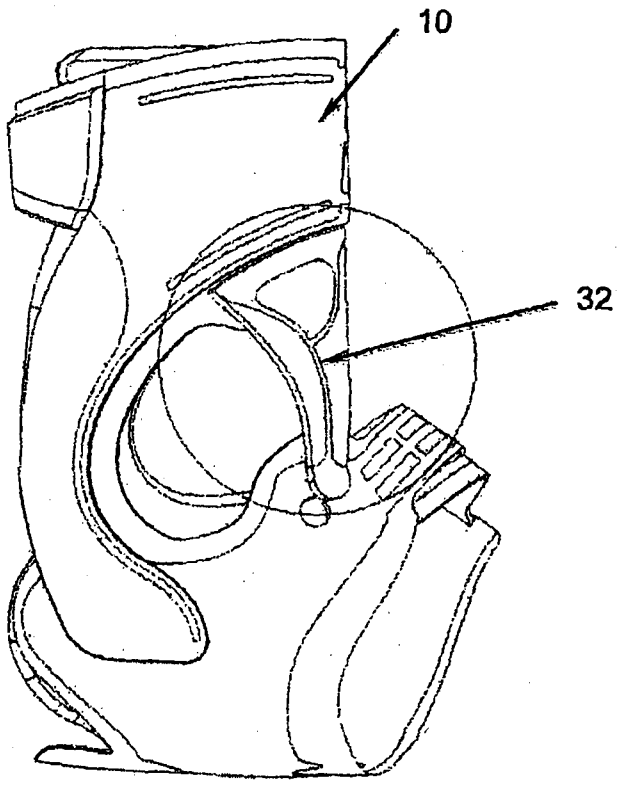


Figure 4

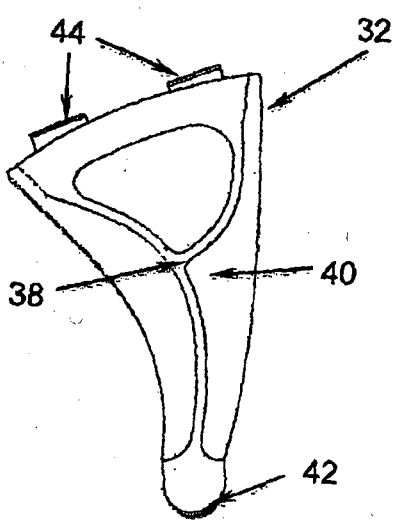


Figure 5

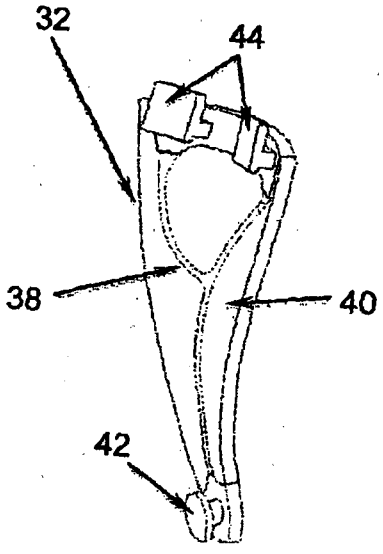


Figure 6

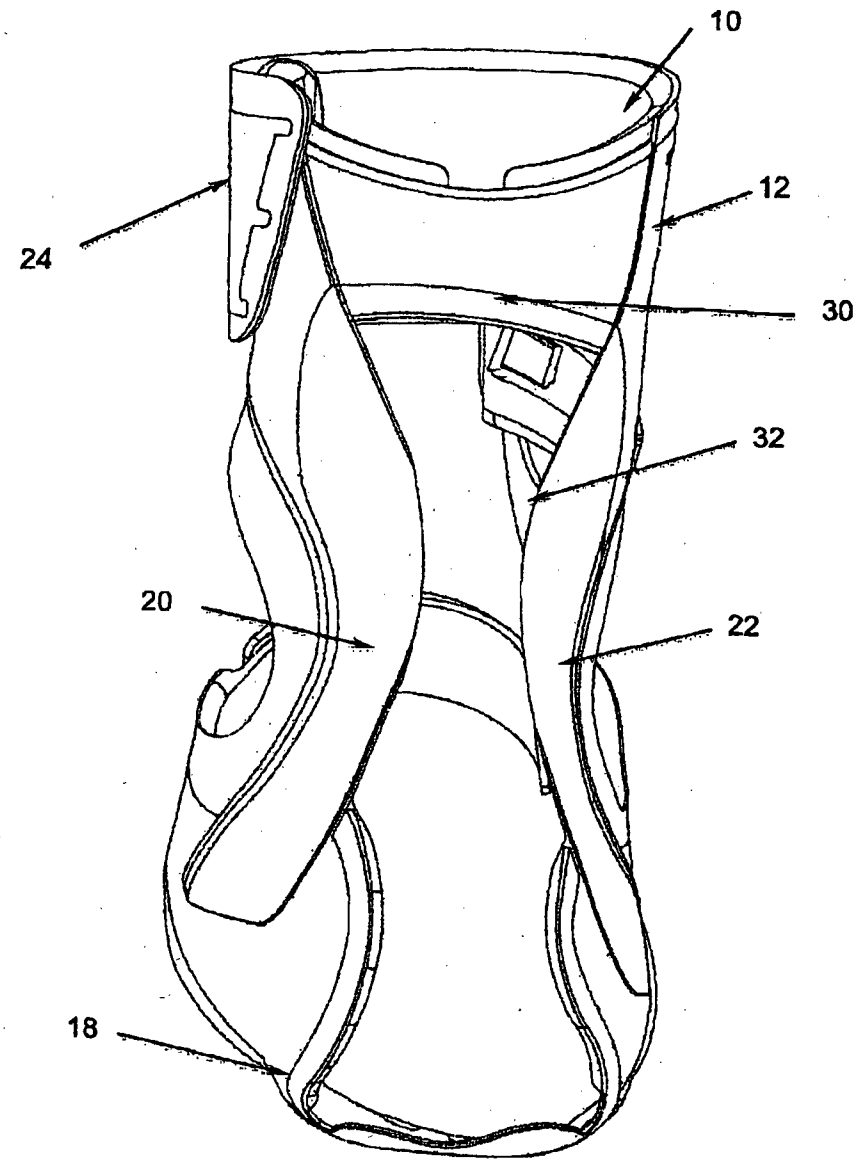


Figure 7

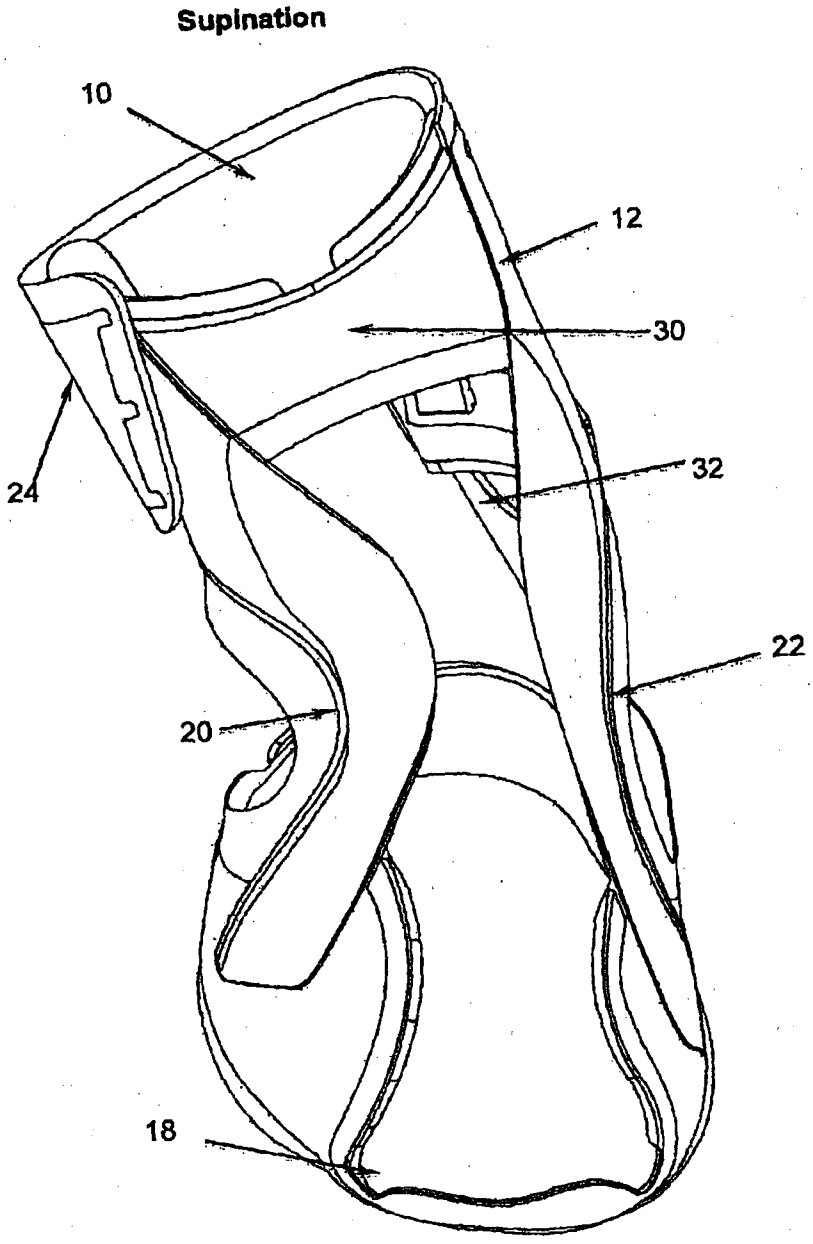


Figure 8

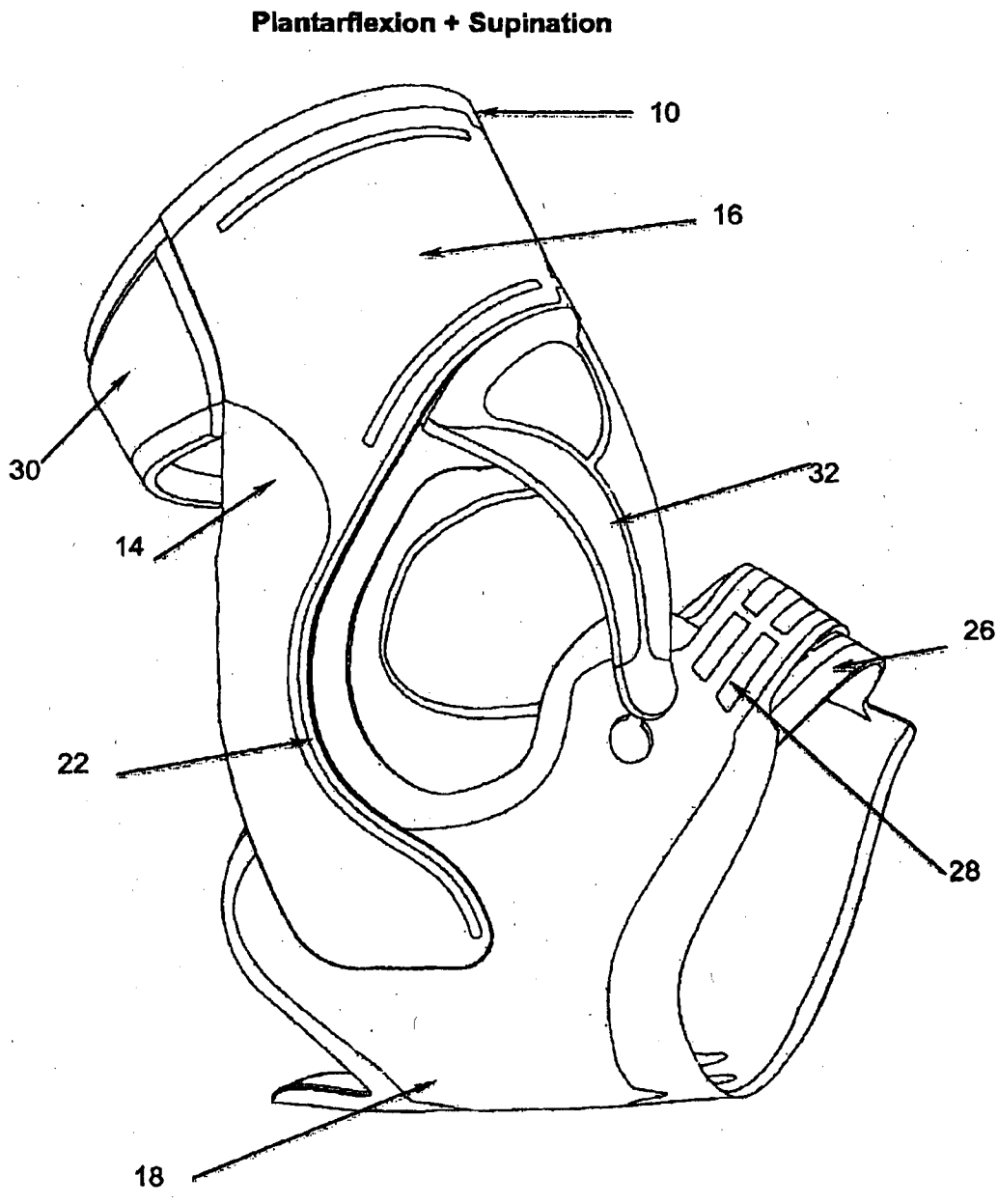


Figure 9

Dorsiflexion

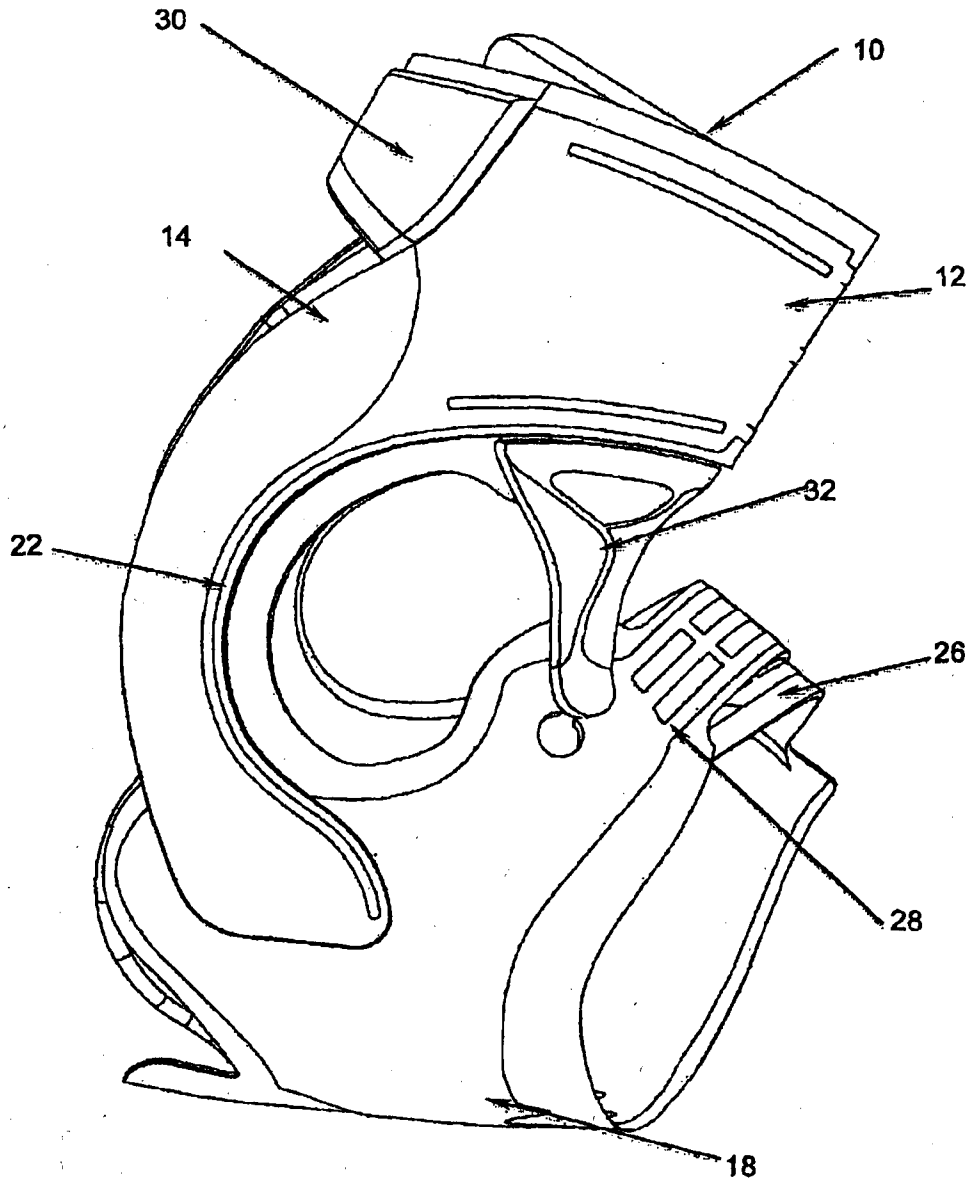


Figure 10

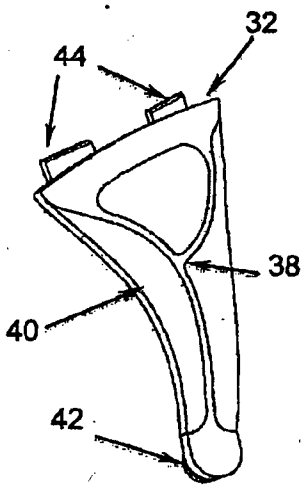


Figure 11

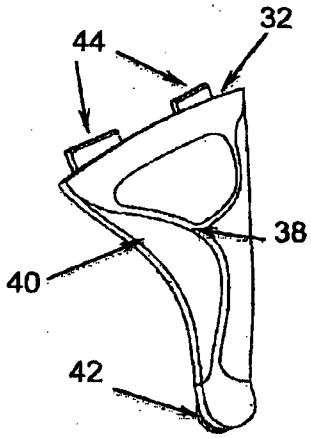


Figure 12

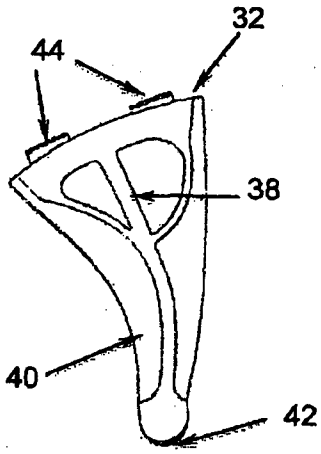


Figure 13

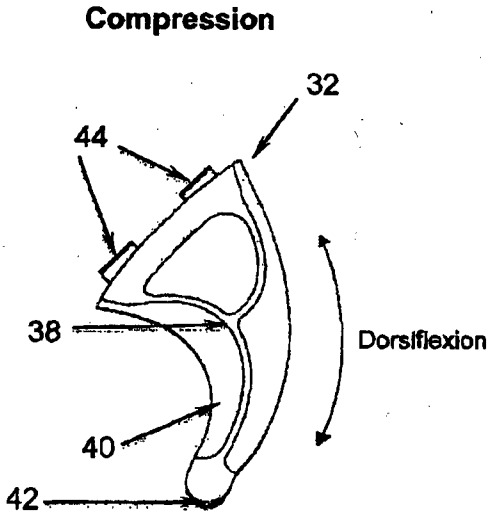


Figure 14

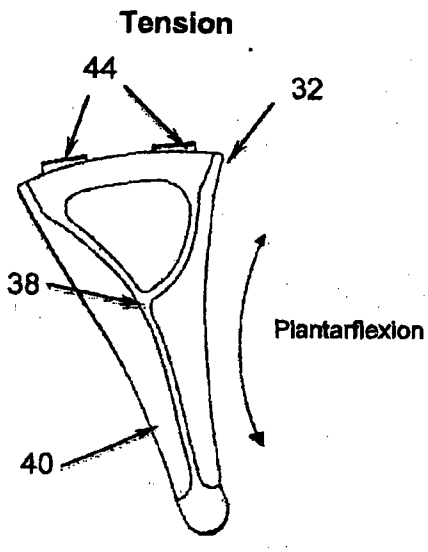


Figure 15

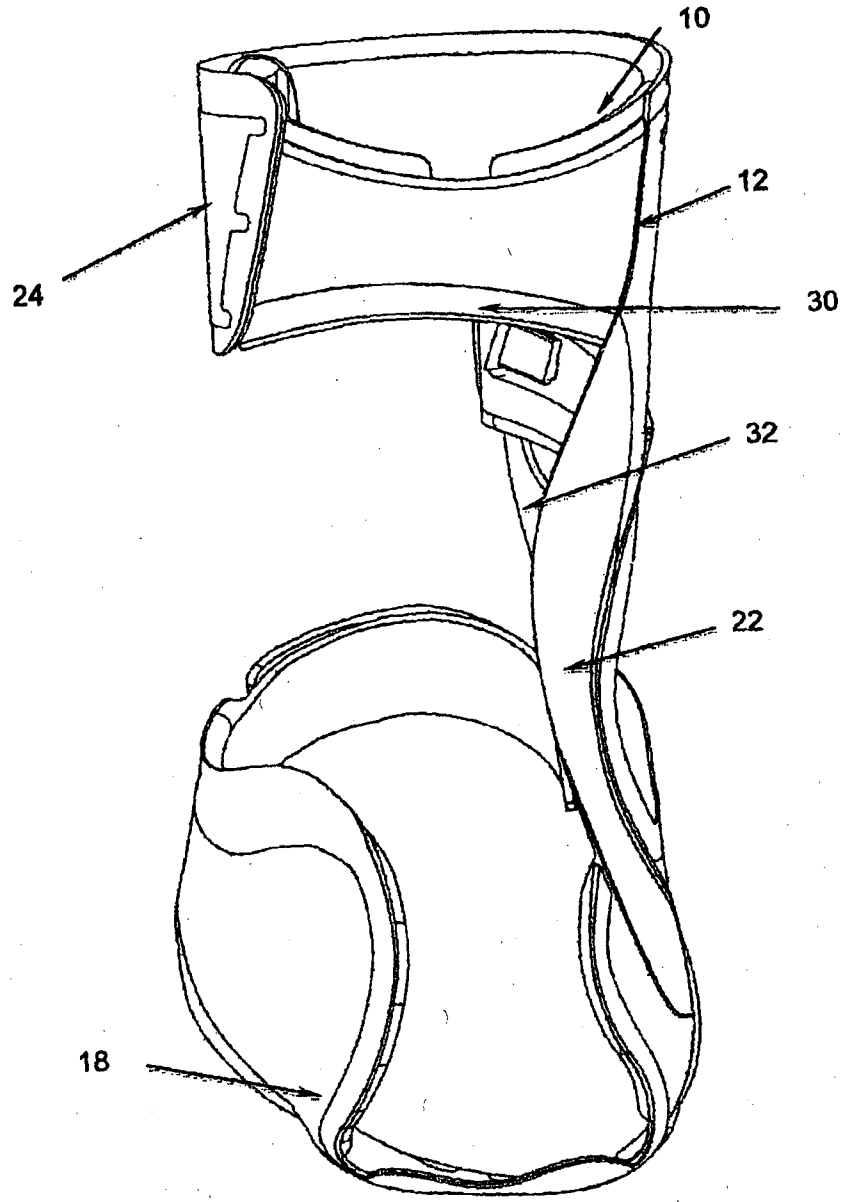


Figure 16

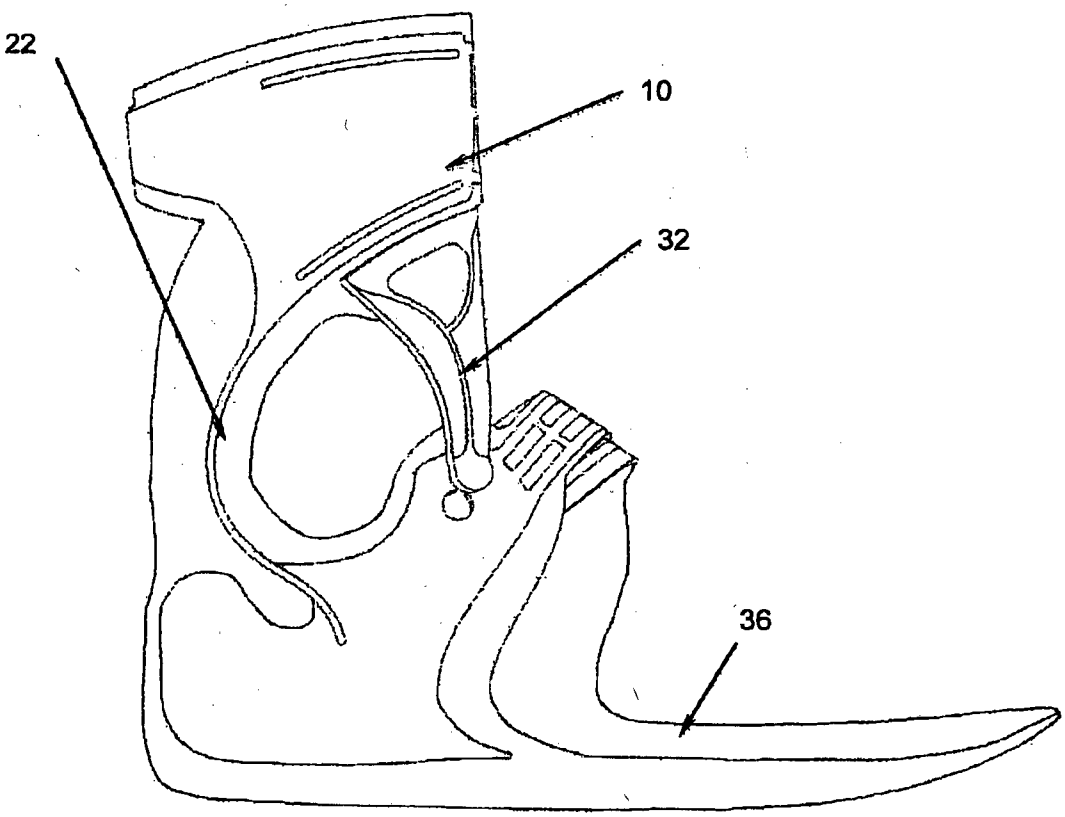


Figure 17

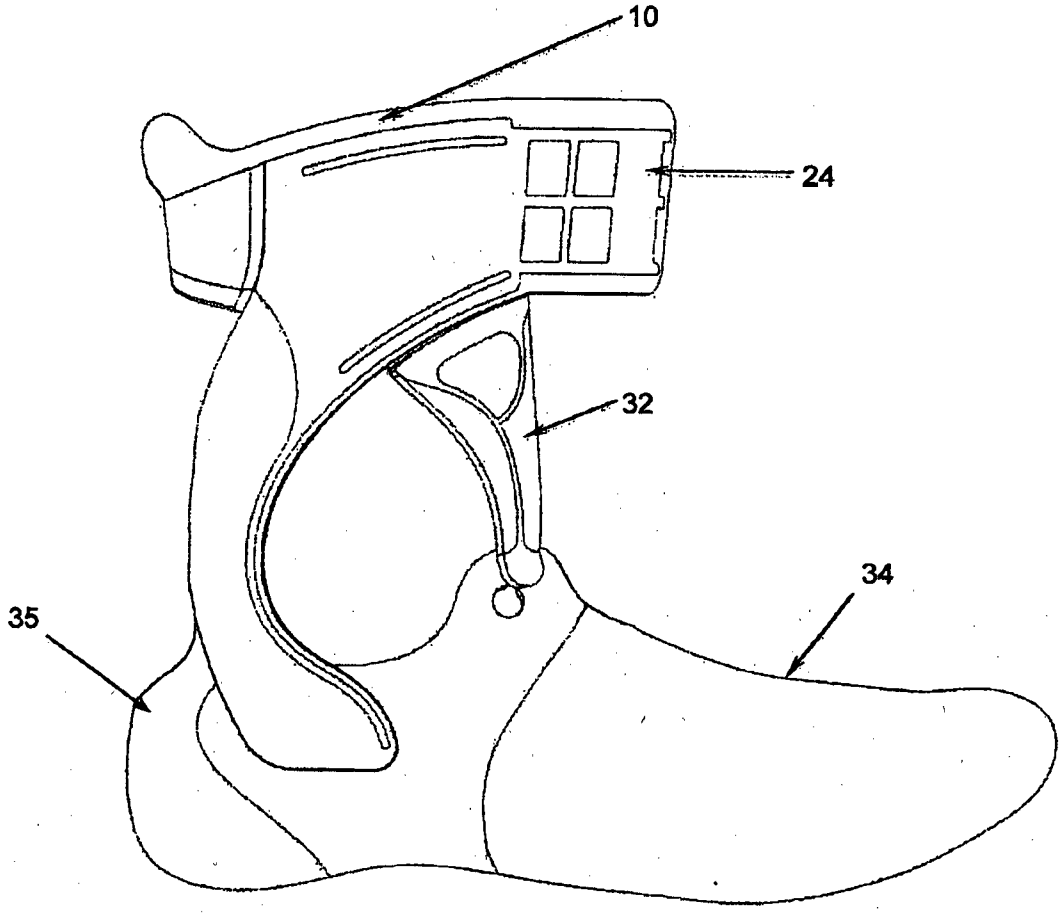


Figure 18

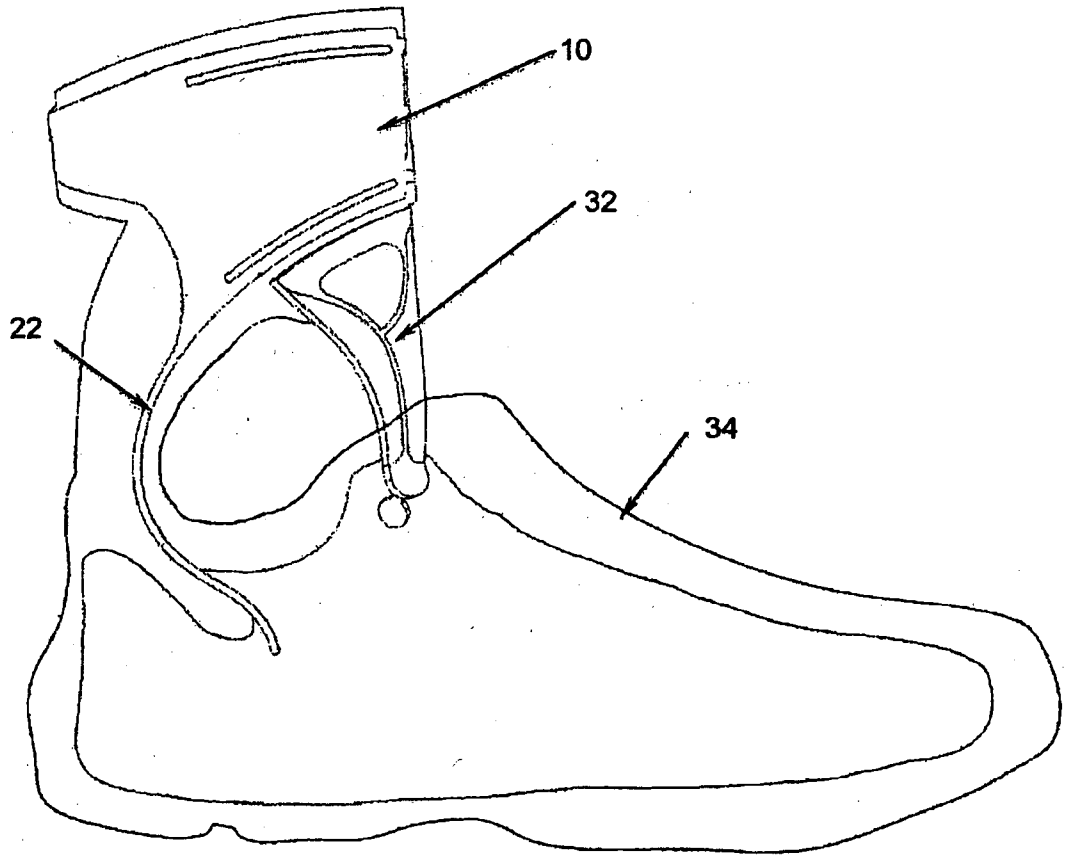


Figure 19

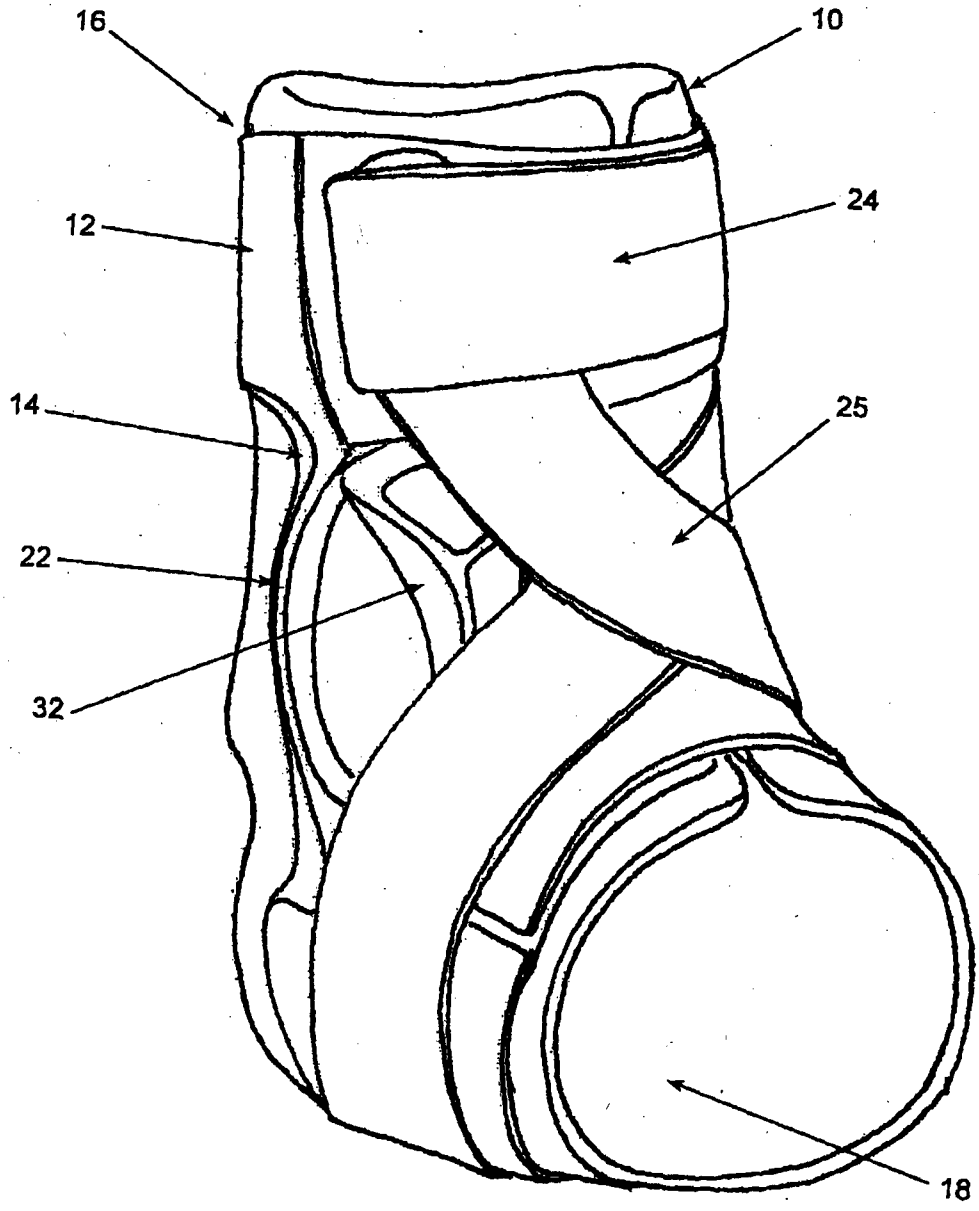


Figure 20

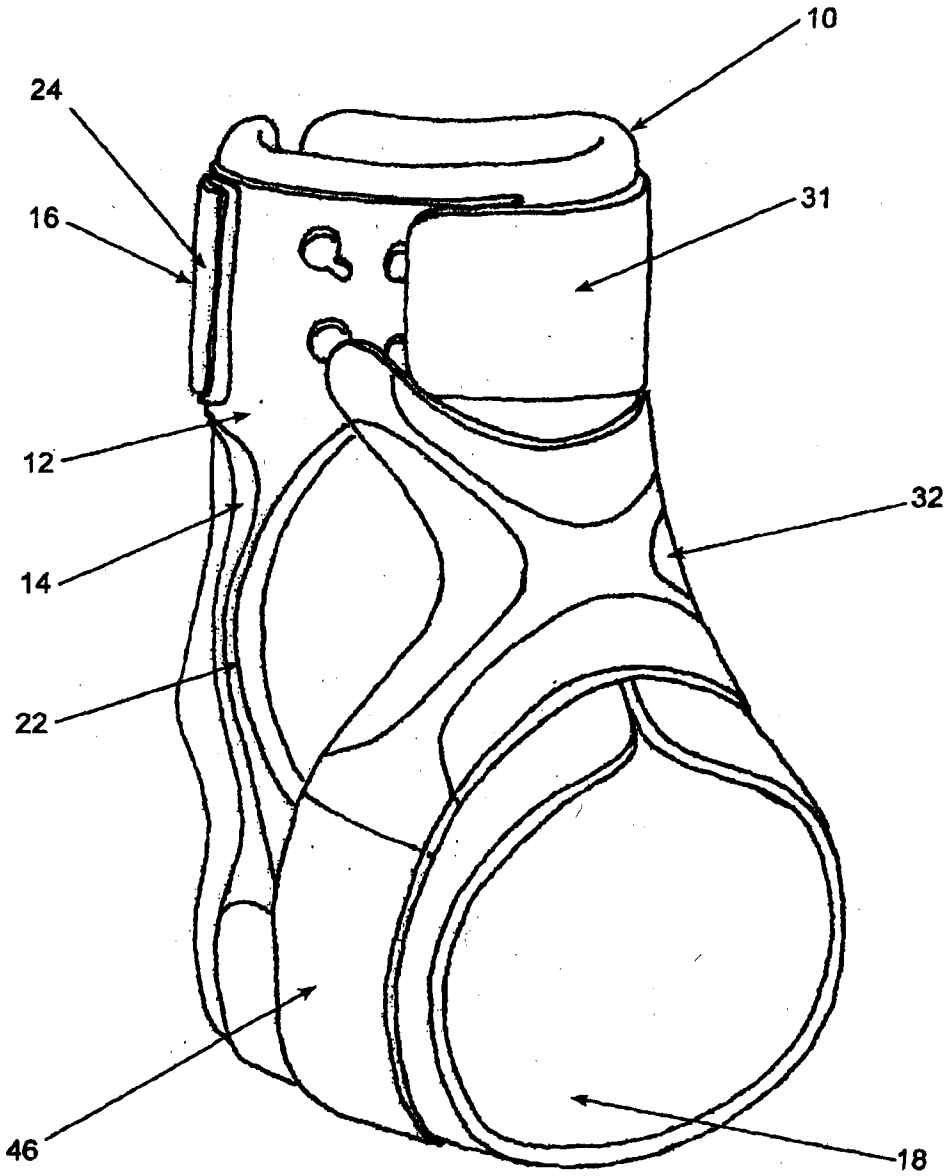


Figure 21

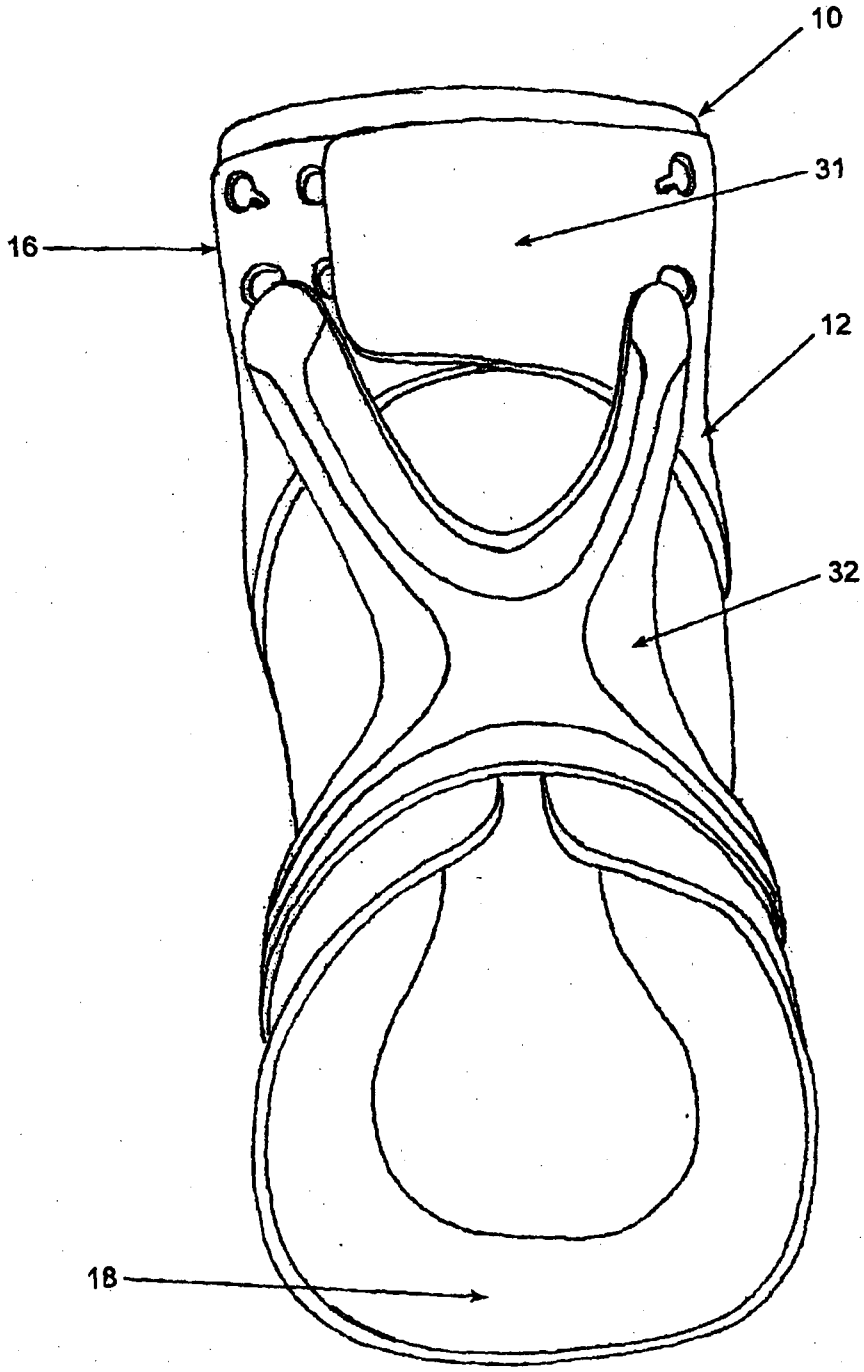


Figure 22

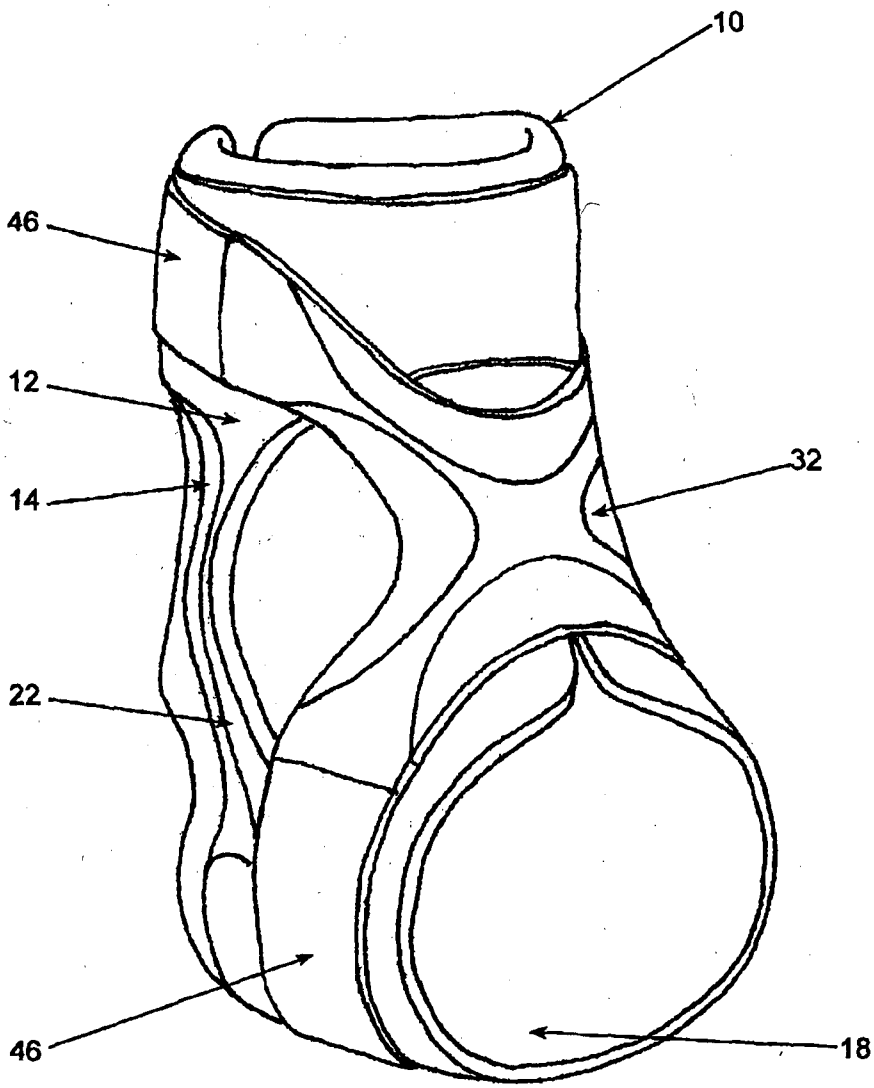


Figure 23

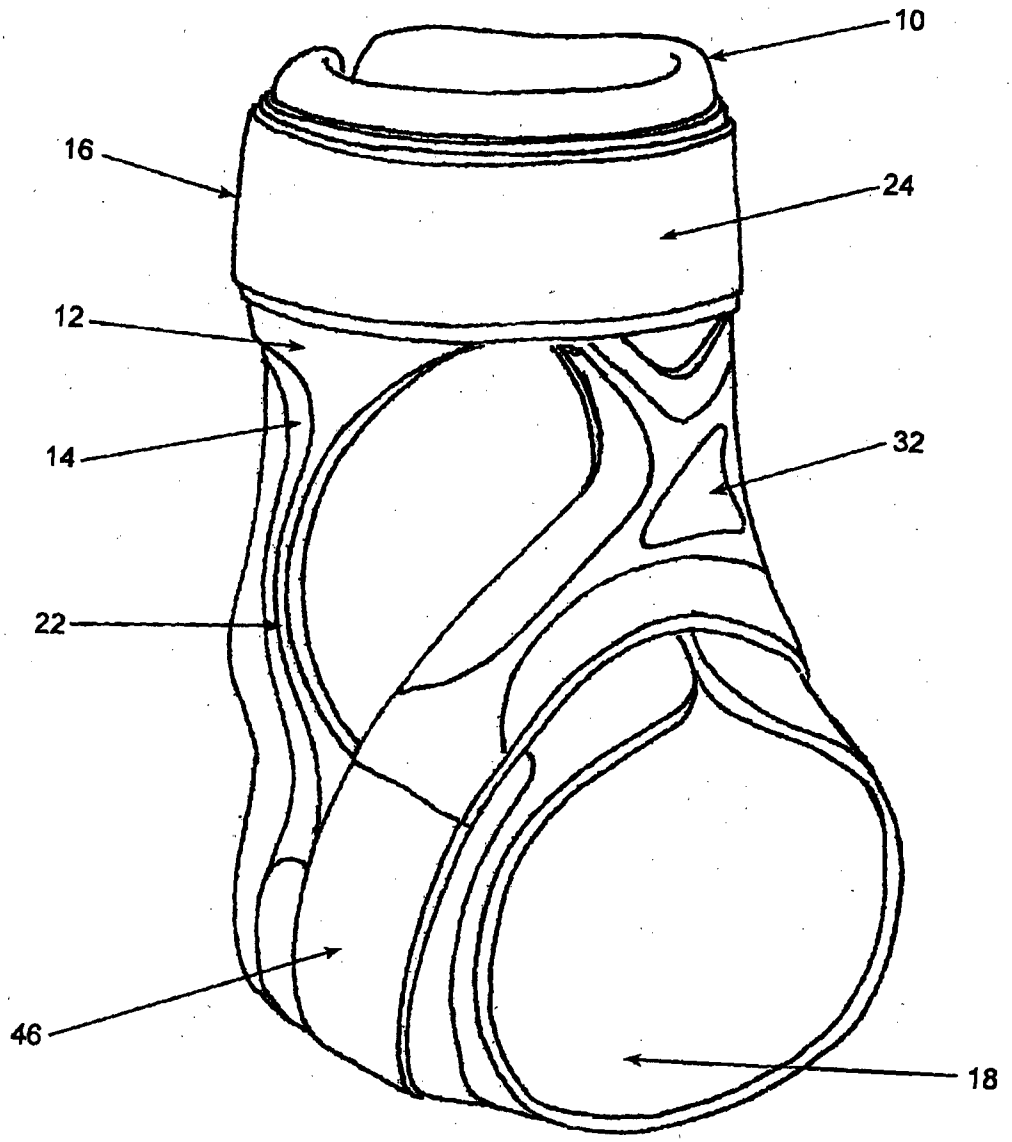


Figure 24

Supination

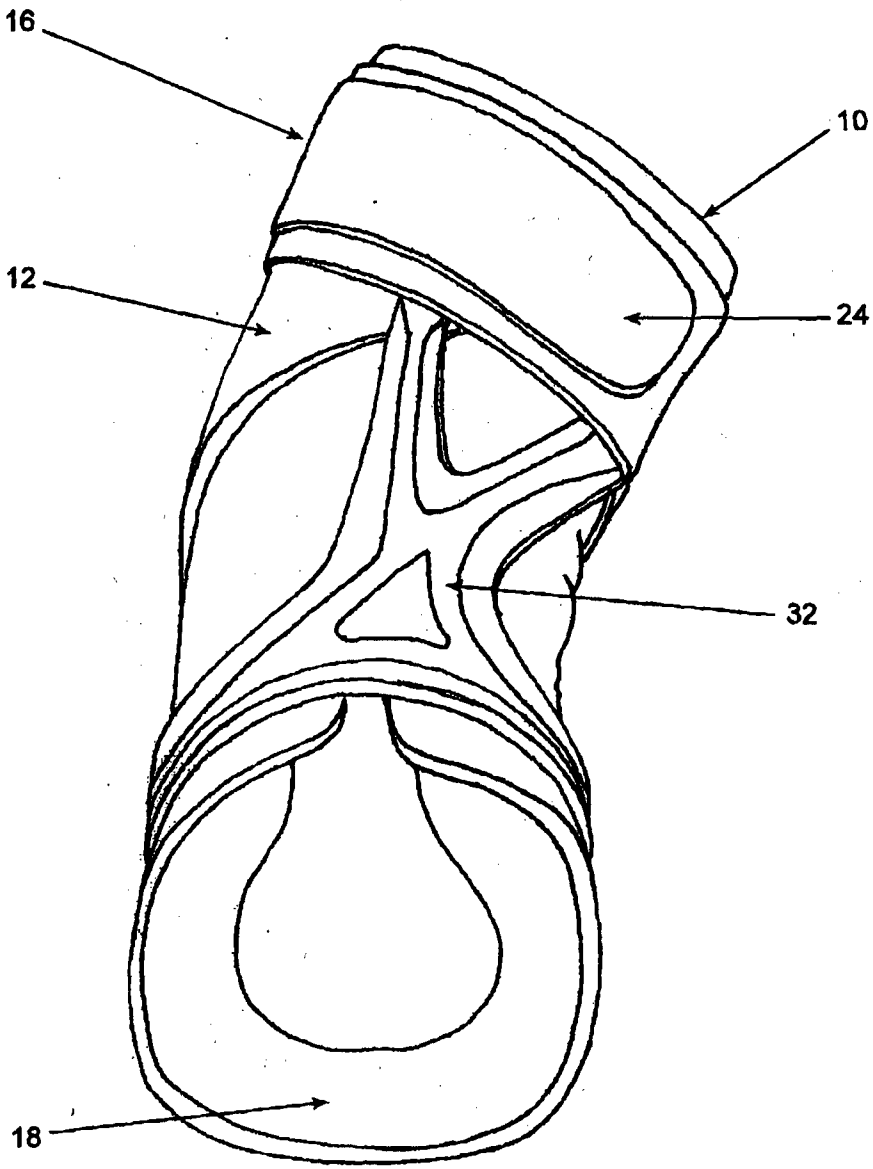


Figure 25

Plantarflexion + Supination

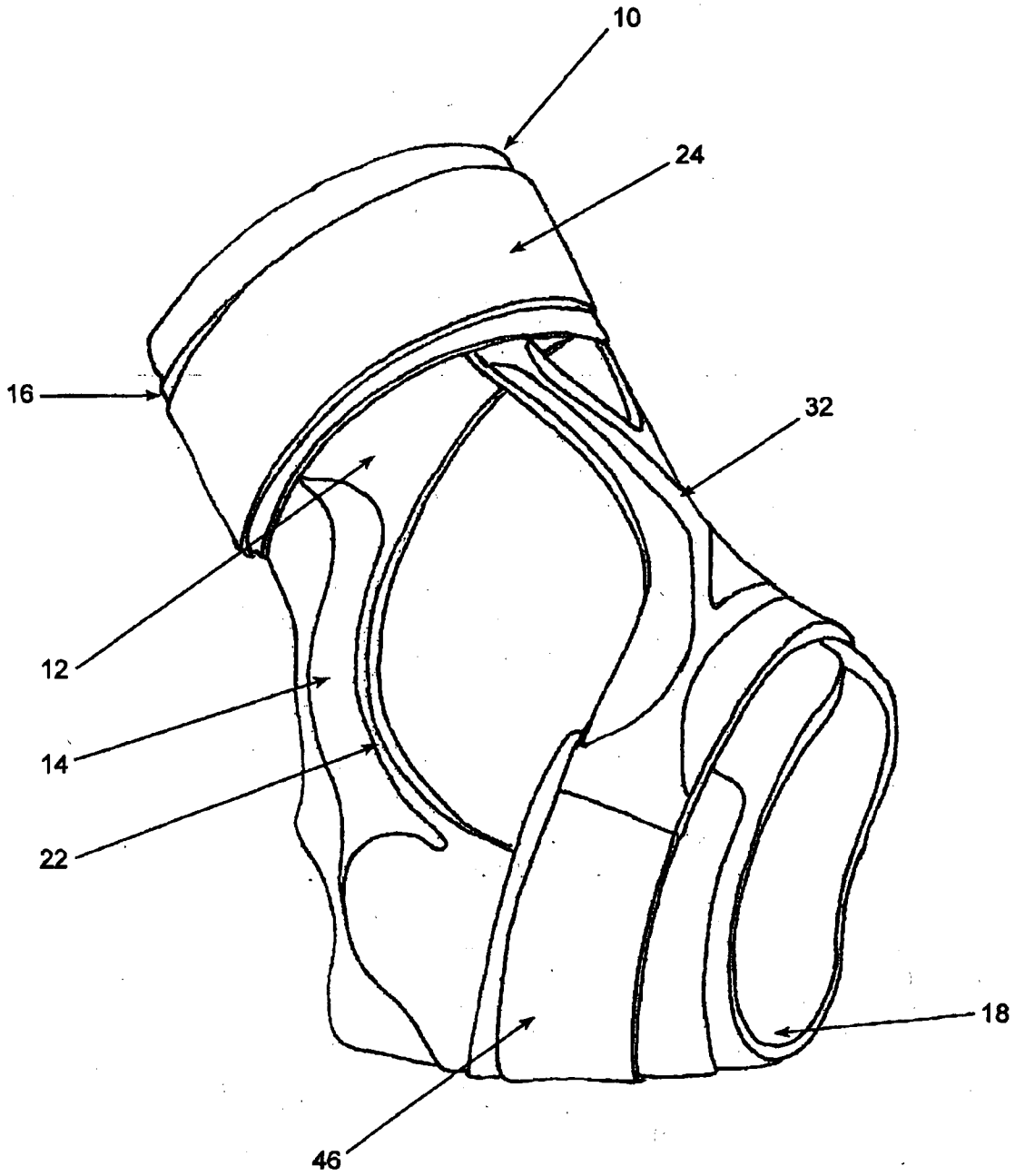


Figure 26

Dorsiflexion

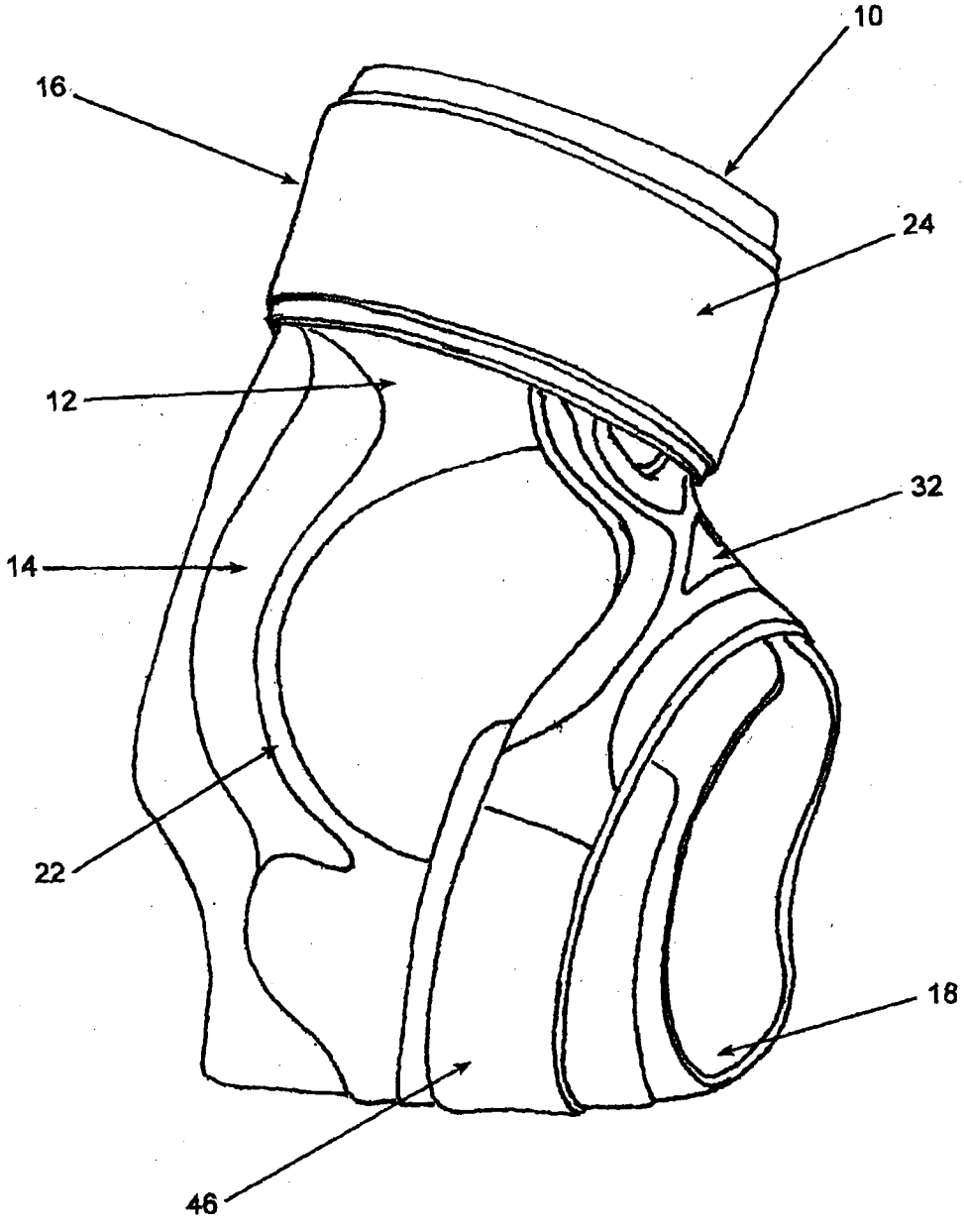


Figure 27

Neutral

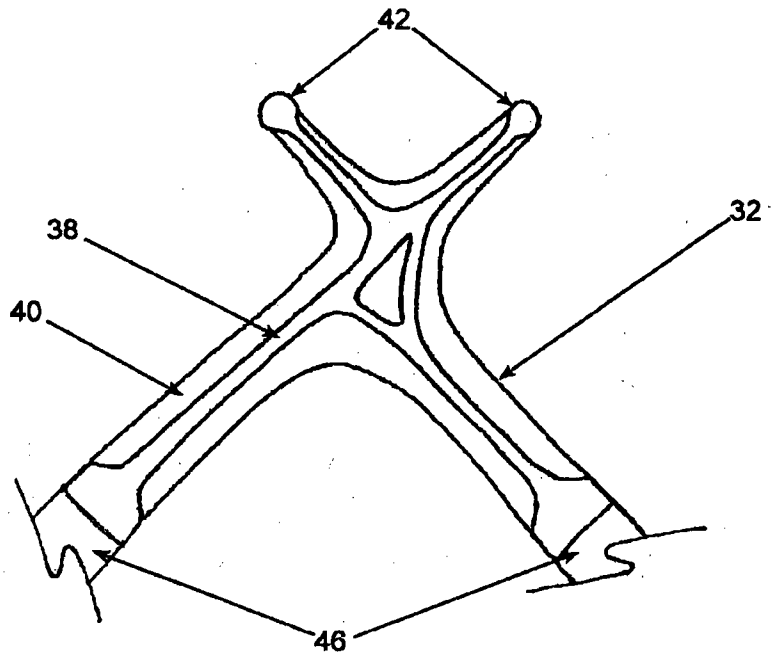


Figure 28

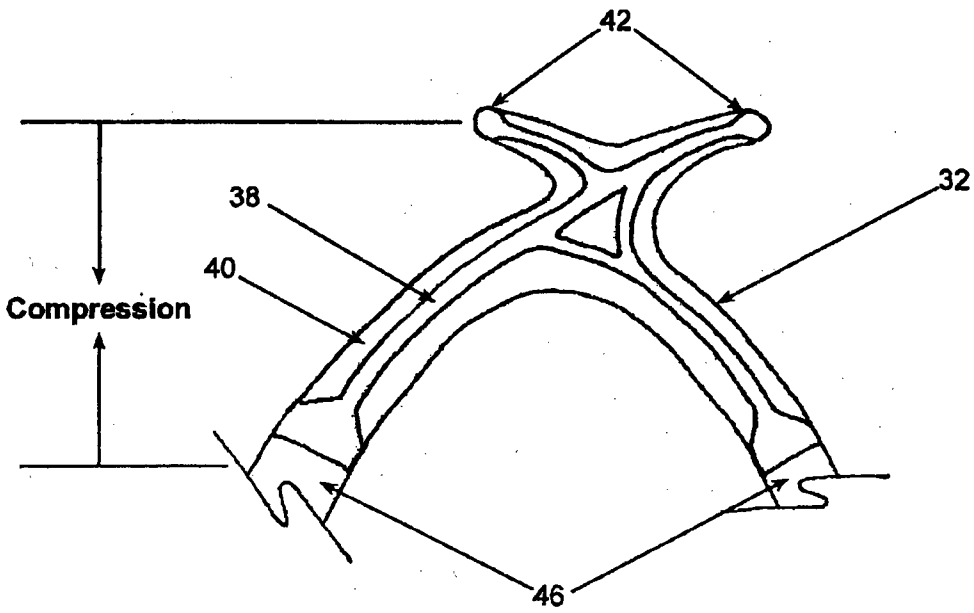


Figure 29

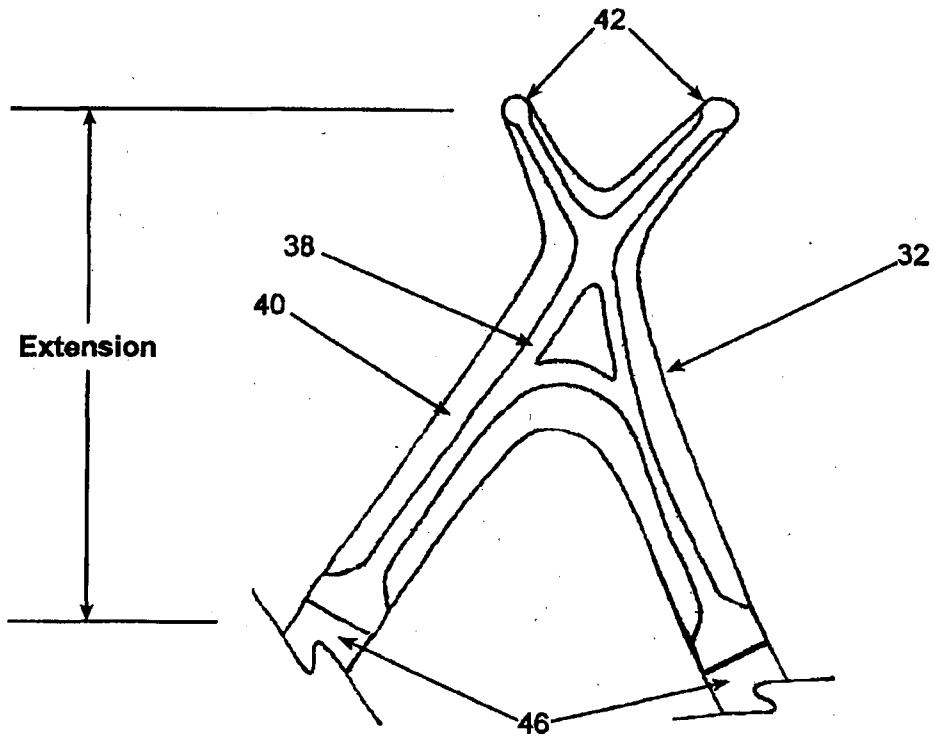


Figure 30

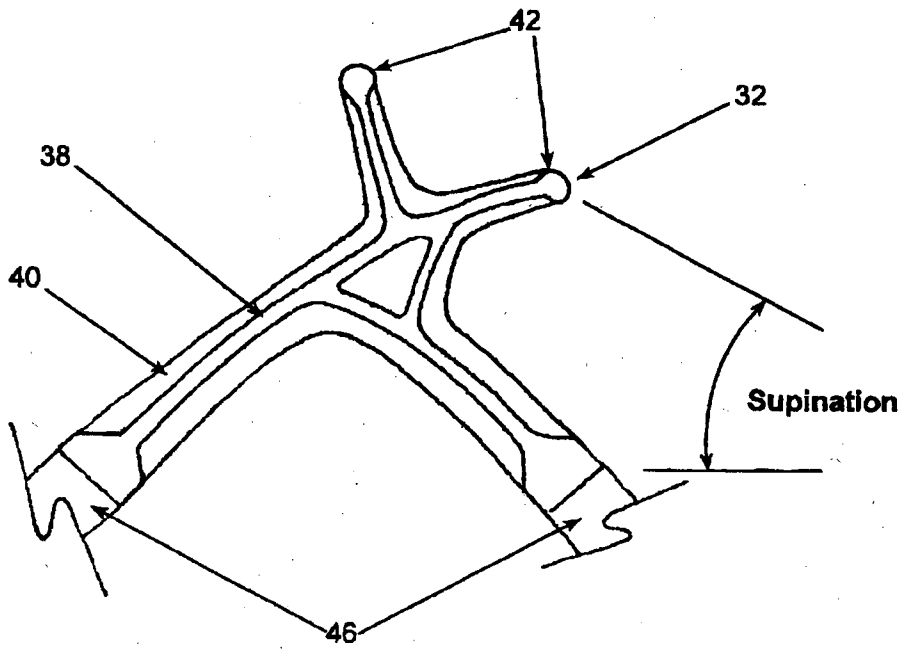


Figure 31

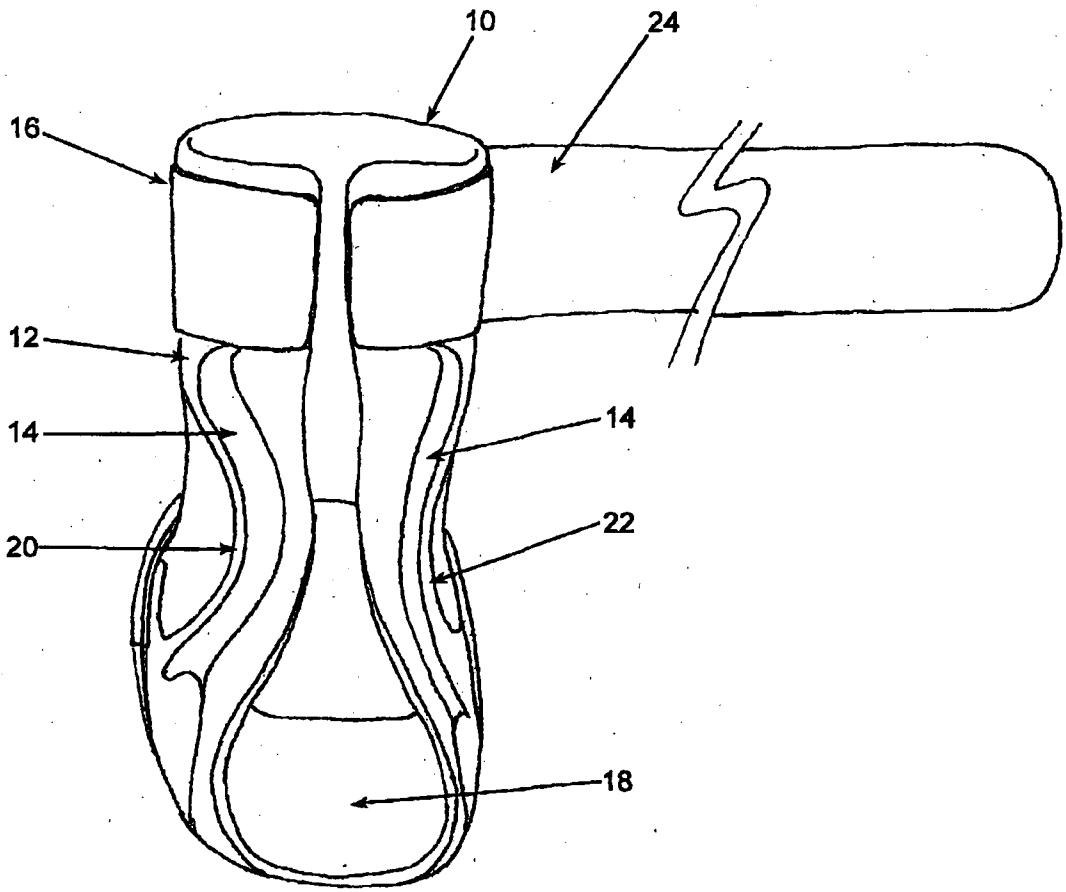


Figure 32

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2013/000655

A. CLASSIFICATION OF SUBJECT MATTER

A43B 7/20 (2006.01) A61F 5/14 (2006.01)

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)

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)

EPODOC - CPC A61F5/0111, A43B7/20, keywords "ankle", "support", "achilles", malleolus" and the like
Google Patents - keywords "ankle", "support", "achilles", malleolus" and the like

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

[X] Further documents are listed in the continuation of Box C [X] 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 application or patent 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 such 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
5 September 2013	05 September 2013

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INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT/AU2013/000655**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5944678 A (HUBBARD) 31 August 1999 Abstract; figures 1-3; column 5, line 21-23; column 5, line 6-11	1-2, 6
X	US 2011/0034846 A1 (DRAPER) 10 February 2011 Figures 12-13; paragraph [0013]	1-4, 6, 10

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/AU2013/000655**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
US 5944678 A	31 Aug 1999	AU 4934193 A	29 Mar 1994
		CA 2118254 A1	17 Mar 1994
		EP 0615431 A1	21 Sep 1994
		US 5944678 A	31 Aug 1999
		WO 9405236 A1	17 Mar 1994
US 2011/0034846 A1	10 Feb 2011	None	

End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.