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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

FREEDOM INNOVATIONS, LLC.,
Petitioner

v.

BLATCHFORD, INC., BLATCHFORD PRODUCTS LTD., & CHAS. A. BLATCHFORD & SONS, LTD.
Patent Owner

Case No. IPR2015-00640
Patent No. 8,740,991
Title: PROSTHETIC ANKLE JOINT MECHANISM

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 8,740,991

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LIST OF EXHIBITS

Exhibit	Description
EX1001	U.S. Patent No. 8,574,312 to David Moser et al, titled, "Prosthetic Ankle Joint Mechanism," filed on Dec. 14, 2007, and issued on Nov. 5, 2013 ('312 patent).
EX1002	File History of U.S. Patent No. 8,574,312.
EX1003	U.S. Patent No. 8,740,991 to David Moser et al., titled "Prosthetic Ankle Joint Mechanism," filed Nov. 6, 2013, and issued June 3, 2014 ('991 patent).
EX1004	File History of U.S. Patent No. 8,740,991.
EX1005	Expert Declaration of Professor John Michael.
EX1006	Complaint, *Blatchford Products Ltd. v. Freedom Innovations, LLC*, No. 1:14-cv-00529, ECF No. 1 (S.D. Ohio filed June 25, 2014).
EX1007	Order, *Freedom Innovations, LLC, v. Chas A. Blatchford & Sons, Ltd.*, No. 2:14-cv-01028, ECF No. 28 (D. Nev. dismissed Oct. 15, 2014).
EX1008	U.S. Patent Application Publication US2004/0044417 to Gramnas et al., titled "Device in a Leg Prosthesis," filed Aug. 22, 2001, published on Mar. 4, 2004 (*Gramnas*).
EX1009	U.S. Patent Application Publication US2005/0171618 to Christensen et al., titled "Prosthetic Foot with Energy Transfer Including Variable Orifice," filed Apr. 4, 2005, published on Aug. 4, 2005 (*Christensen*).
EX1010	U.S. Patent No. 6,443,993 to Koniuk et al., titled, "Self-Adjusting Prosthetic Ankle Apparatus," filed Mar. 23, 2001, and issued on Sept. 3, 2002 (*Koniuk*).
EX1011	U.S. Patent Application Publication US2004/0117036 to Townsend et al., titled "Prosthetic Foot with Tunable Performance," filed Mar. 29, 2002, and published on June 17, 2004 (*Townsend*).
EX1012	U.S. Patent No. 4,212,087 to Mortensen et al., titled, "Prosthetic Leg with a Hydraulic Control," filed, Nov. 16, 1978, and issued on July 15, 1980 (*Mortensen*).
EX1013	U.S. Patent Application Publication US2006/0224248 to Lang et al., titled "Prosthetic Knee Joint Mechanism," filed Mar. 12, 2004, and published on Oct. 5, 2006 (*Lang*).
EX1014	U.S. Patent No. 6,398,817 to Hellberg et al., titled, "Locking Device for a Prosthesis," filed Mar. 21, 2000, and issued on June 4, 2002 (*Hellberg*).

EX1015	DAVID ROYLANCE, ENGINEERING VISCOELASTICITY (Oct. 24, 2001).
EX1016	Eugene F. Murphy, *The Swing Phase of Walking with Above-Knee Prostheses*, BULLETIN OF PROSTHETICS RESEARCH, Spring 1964.
EX1017	BESS FURMAN, PROGRESS IN PROSTHETICS (1964).
EX1018	Edmond M. Wagner, *Contributions of the Lower-Extremity Prosthetics Program*, 1 ARTIFICIAL LIMBS 8 (1954).
EX1019	John Michael et al., *Hip Disarticulation and Transpelvic Amputation: Prosthetic Management*, in ATLAS OF LIMB PROSTHETICS: SURGICAL, PROSTHETIC, AND REHABILITATION PRINCIPLES, Ch. 21B (1992).
EX1020	U.S. Patent No. 2,470,480 to Fogg, titled "Artificial Foot," filed Apr. 23, 1946, and issued May 17, 1949 (*Fogg*).
EX1021	U.S. Patent No. 2,843,853 to Mauch, titled "Control Mechanism for an Artificial Ankle," filed Nov. 26, 1956, and issued July 22, 1958 (*Mauch*).
EX1022	T.T. Sowell, *A preliminary clinical evaluation of the Mauch hydraulic foot-ankle system*, 5 PROSTHETIC ORTHOTICS INT'L. 87 (1987).
EX1023	Felix Starker et al., *Remaking the Mauch Hydraulic Ankle*, CAPABILITIES, Winter 2010, at 1.
EX1024	U.S. Patent No. 2,541,234 to Fulton et al., titled "Hydraulic Buffer Assembly," filed Dec. 13, 1949, and issued Feb. 13, 1951 (*Fulton*).
EX1025	Certified English translation of German Patent DE818828C to Schwarz, with original and Affidavit of Certification (*Schwarz*).
EX1026	U.S. Patent No. 6,517,585 to Zahedi et al., titled "Lower Limb Prosthesis," filed Aug. 13, 1998, and issued Feb. 11, 2003 (*Zahedi*).
EX1027	U.S. Patent No. 2,851,694 to Valenti et al., titled "Artificial Leg," filed June 20, 1955, and issued Sept. 16, 1958 (*Valenti*).
EX1028	U.S. Patent Application Publication US 2006/0235544 to *Iversen* et al., titled "Device and System for Prosthetic Knees and Ankles," filed Mar. 29, 2006, and published Oct. 19, 2006 (*Iversen*).
EX1029	U.S. Patent No. 5,383,939 to James et al., titled "System for Controlling Artificial Knee Joint Action in an Above Knee Prosthesis," filed Dec. 5, 1991, and issued Jan. 24, 1995 (*James*).
EX1030	U.S. Patent 3,659,294 to Glabiszewski et al., titled "Adjustable Link for Prosthetic Limb," filed May 1, 1970, and issued May 2, 1972 (*Glabiszewski*).

I. INTRODUCTION

Petitioner Freedom Innovations, LLC ("Freedom") requests *Inter Partes* Review ("IPR") of claims 1-9 of U.S. Patent No. 8,740,991 (EX1003).

The '991 patent describes a prosthetic ankle joint mechanism that "provide[s] hydraulic damping continuously over the range of dorsi-flexion," with two flexion limits "defining the fixed range of dorsi-plantar flexion." EX1003 at Abstract.

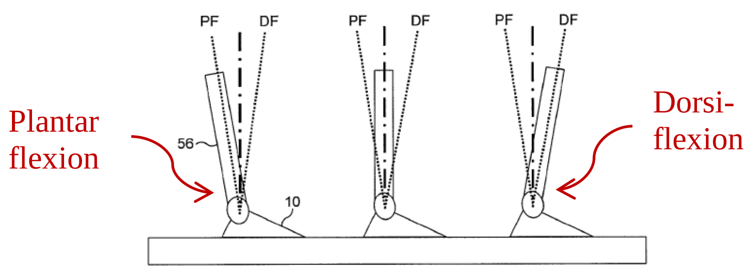

FIG. 5

The prior art, however, is replete with hydraulically damped prosthetic ankle joints, including those in which both dorsi- and plantar-flexion are fixed with limits and have continuous hydraulic-dampened rotation, as required by the claims. *See, e.g.*, EX1008 (*Gramnas*), EX1009 (*Christensen*), EX1010 (*Koniuk*), EX1011 (*Townsend*), EX1022 (*Schwarz*). This Petition will demonstrate that the claims of the '991 patent add nothing of substance over the prior art. Instead, they merely combine conventional features of hydraulically damped ankle joints in a manner that was known or obvious to a person of ordinary skill in the art. Freedom requests that the Board institute IPR, review this patent, and cancel the claims.

II. GROUNDS FOR STANDING

Petitioner certifies that the ’991 patent is available for IPR and that the Petitioner is not barred or estopped from requesting IPR challenging the ’991 patent on the grounds identified. *See* 37 C.F.R. § 42.104(a). Specifically: (1) Petitioner is not the owner of the ’991 patent; (2) Petitioner is not barred or estopped from requesting IPR; and (3) Petitioner files this Petition less than a year after being served with a complaint alleging infringement of the ’991 patent.

III. MANDATORY NOTICES

1. Real Party-in-Interest

Freedom Innovations, LLC is the real party-in-interest. 37 C.F.R. § 42.8(b)(1).

2. Related Matters

The ’991 patent was asserted on June 25, 2014, against Freedom in the U.S. District Court for the District of Ohio. EX1006.[1] Freedom is concurrently filing two petitions, IPR2015-00641, IPR2015-00642, addressing similar claims in related U.S. Patent No. 8,574,312 (EX1001).

[1] The parent ’312 patent was the subject of a declaratory judgment action in the District of Nevada, which was dismissed without prejudice on October 15, 2014. *See* EX1007 at 11. The ’991 patent was not involved.

3. Lead and Back-up Counsel; Consent to Electronic Service.

The signature block of this petition designates lead and back-up counsel and service information. Freedom designates James Barney (Reg. No. 46,539) as lead counsel, and Jonathan R.K. Stroud (72,518) and Daniel Chung (63,553) as back-up counsel. All counsel can be contacted at Finnegan, LLP, 901 New York Ave., NW, Washington, DC 20001. Petitioner consents to electronic service of all documents at Freedom_Ankle_IPRs@Finnegan.com.

IV. FEE PAYMENT

The required fees are submitted under 37 C.F.R. §§ 42.103(a) and 42.15(a). If any additional fees are due during this proceeding, the Office may charge such fees to Deposit Account No. 06-0916.

V. STATEMENT OF PRECISE RELIEF REQUESTED

1. Claims for Which Review Is Requested.

Petitioner requests IPR and cancellation of claims 1-9 of the ’991 patent under 35 U.S.C. § 311.

2. Statutory Grounds of Challenge.

Ground	Proposed Statutory Rejections for the ’991 Patent
1	Claims 1 and 3-8 are rendered obvious under §103(a) by *Koniuk* in view of *Mortensen*
2	Claim 2 is rendered obvious under §103(a) by *Koniuk* in view of

	Mortensen and *Hellberg*
3	Claims 1-9 are rendered obvious under §103(a) by *Townsend* in view of *Mortensen*
4	Claim 9 is rendered obvious under §103(a) by *Koniuk* in view of *Mortensen* and *Townsend*
5	Claims 1 and 3-8 are rendered obvious under §103(a) by *Gramnas* in view of *Mortensen*
6	Claim 2 is rendered obvious under §103(a) by *Gramnas* in view of *Mortensen* and *Hellberg*
7	Claim 9 is rendered obvious under §103(a) by *Koniuk* in view of *Mortensen* and *Townsend*

3. Claim Construction

In IPR, an unexpired patent's claims receive the "broadest reasonable construction in light of the specification of the patent in which it appears." 37 C.F.R. § 42.100(b). Unless otherwise noted, Petitioner proposes that the claim terms of the '991 patent be given their ordinary and customary meaning in the art. The following phrases, however, require construction, as dictated by the intrinsic evidence and traditional canons of claim construction. Freedom uses these constructions in its grounds for unpatentability. *See id.*, § 42.104(4).[2]

(i) *"said resistance"*

Dependent claim 7 uses the term "said resistance." Based on traditional canons of claim construction, "said resistance" refers to the antecedent word "resistance," which appears in claim 1 as a part of the clause "the ankle joint comprising a joint mechanism providing resistance to ankle flexion." Accordingly, the term "said resistance" should be construed to mean: *resistance to ankle flexion provided by the joint mechanism*.

(ii) *"predominantly provided by hydraulic damping"*

Claim 7 recites resistance that is "predominantly provided by hydraulic damping in one or both of the dorsi- and plantar-flexion directions." *Id.* This term should be construed to mean that *during motion of the ankle joint, resistance to movement in the dorsi and/or plantar direction by the joint mechanism is predominantly provided by hydraulic damping rather than resilient biasing.*

The specification supports this construction, which discloses a joint mechanism that provides a "hydraulically damped range of ankle flexion, the

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[2] No court has yet construed the claims. This claim construction analysis is not a concession as to the proper scope of any claim term. Freedom does not waive the right to argue that the claims in the '991 patent are otherwise unpatentable.

mechanism being constructed and arranged such that, over at least part of the range, *movement in the dorsi and plantar directions is substantially unbiased resiliently*." EX1003 at 2:28-32 (emphasis added); *see also id.* at 3:3-6 ("[T]he ankle allows dorsi-plantar flexion over a limited range of movement with largely damped, as opposed to resilient, resistance to motion results in an ankle which is able easily to flex under load"). The specification describes this feature has "advantages" because the "yielding ankle" has "minimal, preferably zero elastic biasing in the dorsi- or plantar directions." *Id.* at 9:21-24.

4. The Level of Ordinary Skill in the Art at the Time of the Claimed Invention.

The earliest possible effective filing date of the '991 patent is December 14, 2006, based on Provisional Application No. 60/869,959. A person of ordinary skill in the art at the time ("POSA") would have had at least five years of prosthetics experience and would have been familiar with hydraulics. *See* EX1005 at ¶17-18.

5. State of the Art at the Time of the Claimed Invention.

Doctors, engineers, and clinicians have been developing prosthetic limbs and joints for millennia. EX1016 at 1, 13, 26; EX1017 at 1. Hydraulically controlled or dampened prosthetic ankle joints have been successful since at least the 1940s. *See, e.g.*, EX1020 (1958); EX1021 at 1 (1956); EX1025 (1949); EX1015 at 8–11 (explaining basic hydraulic damping). Fifty years ago, scholars noted "[t]he obvious and considerable virtues of fluid-controlled mechanisms for providing smooth control of the artificial knee joint over a wide range of cadences." EX1016, at 39. The commercially successful Hydraulik Ankle ("Mauch Ankle") has been available for more than fifty years. EX1021 at 1; EX1023 at 1. The Mauch, the Stewart-Vickers, EX1018 at Fig. 3, and the Schwarz ankle, EX1025 at Abstract, among others, successfully combined adjustable hydraulic dampening with ankle flexion fifty years ago. EX1019 at 544. As the '991 patent acknowledges, various means of hydraulic damping were known for prosthetic ankle joints, such as the "dual piston and cylinder assembly" of *Karas*, the "ball-and-socket joint with a chamber filled with a silicone-based hydraulic substance" of *O'Byrne*, the "adjustable hydraulic damping and resilient biasing members" of *Chen*, the "hydraulic piston and linkage arrangement" of *Gramtec*, and the "hydraulic ankle mechanism with a rotary vane" of *Iverson*. EX1003 at 1:52-2:2.

Using hydraulic damping resistance for ankle joints in both the dorsi- and plantar directions was also well known in 1996. For instance, *Gramnas* disclosed a prosthetic ankle joint in which the range of motion is controlled by a two-chamber adjustable hydraulic piston, such that movement in both the dorsi and plantar direction is hydraulically damped and substantially unbiased resiliently. EX1008 at Figs. 2a-c; *see also* § VII.6, *infra*. Similarly, *Koniuk* taught hydraulically damped ankle flexion provided by a two-chamber hydraulic mechanism. *See* EX1010. And as early as 1964, research was discussing the basic adjustable separate-bypass passageway design. *See* EX1016 at 1964 (one approach is "providing separate bypass tubes or passages and independently adjustable valves for controlling flexion and extension" in lower-limb prostheses). Likewise, pyramid alignment interfaces were common in prosthetics at the time. For instance, *Glabiszewski* (EX1030), *Hellberg* (EX1014), *Townsend* (EX1011), and *Iversen* (EX1028) all taught using pyramid alignment interfaces to modularly adjust existing prostheses.

VI. SUMMARY OF THE '991 PATENT

1. Specification of the '991 Patent

The '991 patent describes an external prosthetic foot and ankle assembly. EX1003 at Abstract. Pivotally mounted, it uses a hydraulic piston-and-cylinder assembly "having a fixed range of dorsi-plantar flexion." *Id.* The specification discloses a "prosthetic ankle joint mechanism [that] provides a continuously hydraulically damped range of ankle flexion, the mechanism being constructed and arranged such that, over at least part of said range, the damping resistance is the predominant resistance to flexion." *Id.* at 2:5-12.

The specification also describes "first and second adjustable valves for independently controlling dorsi-flexion damping resistance and plantar-flexion damping resistance respectively." *Id.* at Abstract. It does so by, among other things, providing "adjustable-area orifices or flow resistance adjusters," *id.* at 8:7-9, which "permit manual adjustment of damping resistance." *Id.* at 8:10. It also variously describes a "flexion limiter," *e.g.*, *id.*at 11:38-39, a "mechanical end-stop," *id.* at 7:7-11, and "abutment of one part of the prosthetic foot and ankle assembly . . . against another part," *id.* at 2:48-50, to limit the range of flexion in both the dorsi- and plantar-direction. All of these elements were known in the art.

2. The '991 Patent Prosecution

The '991 patent issued from continuation Application No. 14/051,775, filed October 11, 2013, which was a continuation of Application No. 11/956,391, now U.S. Patent No. 8,574,312. EX1001, EX1002. In the first Office Action, the Examiner rejected all claims as obvious based on various combinations of *James* (EX1029), *Koniuk* (EX1010), *Janke* (US 5044360), *Lacroix* (US 5913901 A), *Fogg* (EX1020), *Gettman* (US 2490796 A), *Townsend* (EX1011), and *Fulton* (EX1024). EX1004 at 64-77. Applicants interviewed the Examiner on February 18, 2014, and then amended their claims. *Id.* at 162. They cancelled claim 5, amended claims 1 and 4, and added new claims 8, 9, and 10. *Id.* at 157-160. They amended independent claim 1 to require presetting via adjustable-area valve orifices:

> ". . . a piston which is moveable so as to define a pair of variable-volume chambers, one chamber located on ~~opposite sides~~ each side of the piston," . . . "first and second adjustable valves respectively comprising first and second orifices each adjustable in area for independently presetting ~~controlling~~ dorsi-flexion damping resistance and plantar-flexion damping resistance respectively such that during

> walking said first orifice is preset to provide hydraulic damping ~~is provided~~ at a first setting ~~adjustable level~~ whenever the ankle joint is flexed in ~~the~~ a dorsi-flexion direction and said second orifice is preset to provide hydraulic damping at a second setting ~~adjustable level~~ whenever the ankle joint is flexed in ~~the~~ a plantar-flexion direction."

Id at 157. The amendment also replaced mechanical "end-stops" with "abutments." *Id*. In the Interview Summary, the Examiner indicated she discussed only § 103 rejections and *James*, *Koniuk*, and *Gettman*. *Id.* at 172. No mention was made of *Fogg*, *Lacroix*, *Townsend*, or of any further search made on the newly independent claims. *Id.* The Examiner did not provide reasons for allowance but appears to have found that the prior art applied did not suggest or teach presetting hydraulic levels or using adjustable-area orifices in the valves to set the level of hydraulic damping.

VII. CLAIMS 1-9 OF THE '991 PATENT ARE UNPATENTABLE

1. Ground 1: Claims 1 and 3-8 Are Rendered Obvious Under 35 U.S.C. § 103(a) by *Koniuk* in View of *Mortensen*

a. **Koniuk** ***Discloses Most Limitations of Claims 1 and 3-8***

Koniuk (EX1010) was published on September 3, 2002, and is prior art to the '991 patent under 35 U.S.C. § 102(b). Koniuk was relied on as a secondary hydraulic ankle reference in prosecution. EX1004 at 68. As explained below, *Koniuk* discloses nearly every limitation of claims 1 and 3-8 of the '991 patent, and the remaining limitations would have been obvious in view of *Mortensen.*

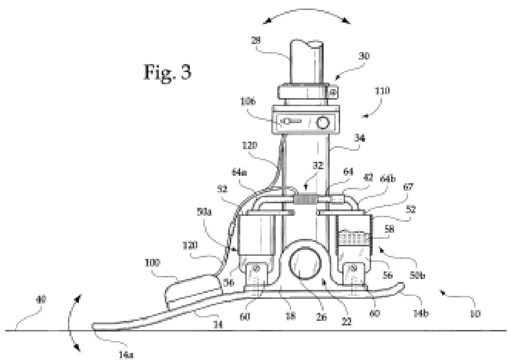


Fig. 3

Claims 1 and 3-8 of the ’991 patent require “[a] prosthetic foot and ankle assembly” comprising a “foot component” and “an ankle component mounted to the foot component.” Figure 3 of *Koniuk* (reproduced below) illustrates a prosthetic ankle and foot apparatus 10, which includes a foot blade 14 connected to a base portion 18. *See also id.* at 6:4-10.

Claims 1 and 3-8 of the ’991 patent also require an ankle joint “having a fixed range of dorsi-plantar flexion during walking” and comprising “a joint mechanism providing resistance to ankle flexion.” *Koniuk* satisfies these limitations because it discloses that a “damping means is included . . . , which is preferably directly and functionally coupled between [a] base portion 18 and [an] attachment portion 34.” *Id.* at 6:23-28; *see also id.* at 7:66-8:3. This means “enable[s] a damping level to be established that affects the pivoting of the ankle apparatus 10,” *id.* at 6:23-26; it “enables a level of damping applied to a relative motion between the base portion 18 and the attachment portion 34,” *id.* at 6:29-31.

Koniuk explains that the “damping applied resist[s] motion between the base portion and the attachment portion.” *Id.* at 4:43-45. The damping means “include[s] a hydraulic system including one or more hydraulic cylinders,” *id.* at 6:34-36, to “lightly damp or heavily damp a relative motion between the base portion and the attachment portion as a user is walking," *id.* at Abstract. "[E]ach hydraulic cylinder 50 is structured having a cylinder casing 52 and an associated piston 56. . . . One or more sealing rings (compression rings) may [be] included for containing the hydraulic fluids within the hydraulic cylinders." *Id.* at 8:23-28. In the embodiment shown in Figure 3, the hydraulic system includes a first hydraulic cylinder 50a that resists pivoting motion of the attachment portion 34 in a counterclockwise direction towards a front portion 14a of the foot blade 14 (i.e., dorsi-flexion) and a second hydraulic cylinder 50b that resists pivoting motion of the attachment portion 34 in a clockwise direction towards a heel portion 14b of the foot blade 14 (i.e., plantar-flexion). *See also id.* at 6:46-57.

Claims 1 and 3-8 of the '991 patent further require "a hydraulic linear piston and cylinder assembly having a piston which is movable so as to define a pair of variable-volume chambers . . . which is constructed and arranged to provide hydraulic damping continuously over the range of dorsi-plantar flexion." As explained above and as illustrated in Figure 3, *Koniuk* discloses a piston-and-cylinder arrangement defining a pair of variable-volume chambers 50a and 50b, each having a piston 56 that is movable within the chamber, and with fluid exchanged through conduit 64. This arrangement provides hydraulic damping continuously over the range of motion. *See* EX1010 at 6:38-46 ("[D]amping is realized by a dynamically controlled damping of a pivoting motion of the ankle that simply controls a rate of flow of fluid that is transferred from a first internal pressure chamber 58 to a second internal pressure chamber. . . . [F]luid is transferred from one hydraulic cylinder to a second by way of a fluidic coupling, which may be termed a fluid transfer conduit 64.”). Although the embodiment in Figure 3 includes two cylinders and pistons, *Koniuk* expressly contemplates a piston-and-cylinder arrangement with a single, linear cylinder and piston, as claimed in the ’991 patent. *See id.* at 9:23-28 (“Alternately, a single hydraulic cylinder may be employed (not illustrated) having a plurality of internal pressure chambers 58 . . .”); *see* EX1005 at ¶37. Thus, this limitation is satisfied.

Claims 1 and 3-8 also require “a valve arrangement controlling the flow of hydraulic fluid between said chambers” comprising “first and second adjustable valves” for “independently presetting dorsi-flexion damping resistance and plantar-flexion damping resistance.” *Koniuk* discloses that the damping means controls the level of damping by “altering the resistance to fluid flow through [the] fluid transfer conduit,” *id.* at 6:58-60, and recognizes that the level of damping may be “established at one of a first damping level or a second damping level, or possibly any level therebetween,” *id.* at 6:28-33. *Koniuk* explicitly recognizes that “conventional damping control arrangements, including piezo-type values [*sic*, valves], controllable pet-cock arrangements, and other flow control mechanisms available” may be used to alter the resistance to fluid flow between the hydraulic cylinders 50a, 50b. *Id.* at 6:65-7:2. Further, *Koniuk* expressly contemplates such variable damping capability in a single piston-and-cylinder arrangement. *See id.* at 9:23-29 ("Alternatively, a single hydraulic cylinder may be employed (not illustrated) . . . having required fluidic couplings, through which the flow rate of fluid can be set to at least two levels, enabling the establishing of a first damping level and a second damping level."). To the extent that *Koniuk* does not expressly disclose the use of two independently adjustable valves, this feature would have been obvious in view of *Mortensen*, as explained below.

Claims 1 and 3-7 further require a "first flexion limiter that limits dorsi-flexion" and a "second flexion limiter that limits plantar-flexion . . . thereby defining said fixed range of dorsi-plantar flexion," wherein the flexion limiters comprise "mechanical abutments." This limitation is met because *Koniuk* discloses that the damping means limits the pivoting or flexing of the attachment portion 34 to a fixed range of dorsi-plantar flexion relative to the foot blade 14. *See id.* at 2:30-37 ("[A] pivoting motion may include a range of plus/minus 10 to 30 degrees, and may enable a pivoting to any selected position between a first position and a second position."). To mechanically define the ends of this range, *Koniuk* discloses that each hydraulic cylinder 50a, 50b is "structurally coupled to the attachment portion" via a "mounting plate," *id.* at 8:1-5, and that the lower portion of each piston 56 includes a "support bumper 60" coupled to the base portion 18 on the foot blade 14, *id.* at 8:28-32. Thus, as the attachment portion 34 approaches the maximum limit of dorsi-plantar flexion (e.g., 10^{o} counterclockwise rotation and 30^{o} clockwise rotation), a piston 56 is forced upward into its respective cylinder 50a, 50b until it engages the top of the cylinder chamber, preventing further flexion. *See* EX1005 at ¶31-35.

More specifically, as shown in Figure 3, pistons 56 move within hydraulic cylinder casings 52 of the hydraulic cylinders 50a, 50b. EX1010 at 4:13-15; 8:21-23. Each cylinder casing 52 includes a mechanical end that represents the maximum displacement possible, where the piston 56 mechanically abuts the top end of, and fills, one hydraulic cylinder, either cylinder 50a or 50b. *See id.*, Fig. 3; EX1005 at ¶32-35.

Dependent claim 6 further requires that the "hydraulic damping provided by the hydraulic linear piston and cylinder assembling is non-electronically controlled." As explained above, the hydraulic damping in *Koniuk* results from fluid passing through transfer conduit 64. Although *Koniuk* discloses an embodiment that uses a magnetorheological fluid, it also makes clear that "*any* arrangement that is structured to control a flow rate" of the fluid through conduit 64 will suffice, including "controllable pet-cock arrangements, and other flow control mechanisms." EX1010 at 6:60-7:3 (emphasis added); *see* EX1005 at ¶39**.** Thus, *Koniuk* expressly discloses non-electrically controlled hydraulic damping.

Dependent claim 7 further requires that, "during walking, said resistance to ankle flexion [i.e., the resistance provided by the ankle mechanism] is predominantly provided by hydraulic damping in one or both of the dorsi- and plantar-flexion directions." *Koniuk* discloses this limitation. As noted above, the damping means in *Koniuk* provides hydraulic resistance to dorsi- and plantar-flexion by controlling the rate of fluid flow through a fluid transfer conduit 64 that fluidly couples the first and second hydraulic cylinders 50a, 50b. *See id.* at 6:38-46. Notably, this damping mechanism includes no resilient biasing of the attachment portion 34 in either the counterclockwise or clockwise direction during movement of the attachment portion 34.[3] *See* EX1005 at ¶40. Thus, damping provided by the ankle joint mechanism is predominantly provided by hydraulic damping, rather than by resilient biasing.

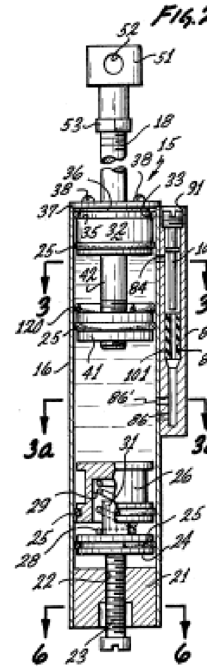
b. ***Mortensen* Cures Any Deficiencies of *Koniuk***

Mortensen (EX1012) was not cited in prosecution. EX1004. With respect to the limitation in claims 1 and 3-8 of the '991 patent requiring a "linear piston and

[3] Although the foot blade 14 provides resilient resistance to dorsi-flexion, that blade is not part of the ankle joint mechanism. Thus, looking only at the resistance provided by the ankle joint mechanism (as required by claim 7), it is clear that all such resistance is provided by hydraulic damping, not by resilient resistance.

cylinder assembly," *Mortensen* discloses a single, linear hydraulic cylinder 16 and piston 41 for controlling flexion of a prosthesis. *See* EX1012 at Abstract; *id.* at 1:35-38. Fig. 2 of *Mortensen* (right) illustrates *Mortensen*'s hydraulic cylinder and piston. *Mortensen* describes that hydraulic cylinder 16 and a piston 41 control the relative pivoting motion between two components of the prosthesis. *Id.* at 2:6-15 ("[T]he shank portion 13 and the thigh portion 12 pivot relative to each other about bolt 14 in a standard manner. This pivot or knee action is controlled by . . . a cylinder 16 . . . and [] a connective rod 18.").

FIG. 2



Regarding the limitation in claims 1 and 3-8 of two independently controllable adjustment valves, *Mortensen* discloses this feature. Specifically, *Mortensen* teaches two hydraulic passageways and an adjustable two-valve system for controlling the flow of hydraulic fluid between opposite regions in the hydraulic cylinder 16 caused by linear movement of the piston 41 within the cylinder 16. *Id.* at Abstract ("One of the passageways has a one-way adjustable valve . . . , and the other passageway has a one-way adjustable valve."); *id.* at 3:44-45 ("When the knee flexes or bends, piston 41 moves down into the cylinder 16 while urging oil out. . . . When the leg tends to extend, the piston 41 moves towards the crank end, urging oil out."). The volume of hydraulic fluid within those opposite regions is variable based on the displacement of the piston 41 within the cylinder 16. *See id.* *Mortensen*'s two, one-way adjustment valves allow a user to independently control, and therefore "preset," the resistance to flexing in either direction between the two components of the prosthesis. *See id.* at 1:35-38 ("A primary object of this invention is . . . control for a leg prosthetic wherein the resistance of flexion is not the same as the resistance to extension."); *see also id.* at Abstract.

As illustrated in Figs. 4-5 of *Mortensen*, the one-way valves include adjustable heads 103, 113 that each individually control the hydraulic fluid flow between the opposite regions in the hydraulic cylinder 16 by screwing into and out of wells 82, 83 of the passageways, which controls the size of the orifice and therefore the resistance and the rate at which the two components of the prosthesis flex or pivot relative to each other in a first and a second direction. *See id.* at 3:11-13 ("[b]ypass well 82 controls the rate at which the leg extends itself and well 83 controls the rate at which the leg flexes"); *id.* at 3:44-66. By screwing the adjustable head 103 into and out of the well 82, the user can preset a first hydraulic damping resistance level provided by the hydraulic cylinder 16 and piston 41 for flexion of the prosthesis in the first direction, and by screwing the adjustable head 113 into and out of the well 83, the user can preset a second hydraulic damping resistance level provided by the hydraulic cylinder 16 and piston 41 for flexion of the prosthesis in the second direction. *Id.*

Regarding the requirement in claim 3 that the "medial-lateral joint flexion axis is located to an anterior of the central axis of the linear piston and cylinder assembly," *Mortensen* discloses this feature. Specifically, *Mortensen* teaches a bolt 14 acting as a pivot for two components of the prosthesis, the bolt 14 positioned in front of the hydraulic cylinder 16 and piston 41 relative to the user. *See id.* at Fig. 1; *id.* at 4:30-39. *Koniuk* similarly discloses a "hydraulic cylinder 50b that is positioned behind the attachment portion 34, closer to a heel portion of an attachable foot blade" with the attachment portion 34 and the ankle pivot pin 26 in front of that hydraulic cylinder 50b. EX1010 at 6:52-54. Thus, the combined teachings of *Koniuk* and *Mortensen* teach an ankle pivot pin positioned to the anterior of the central axis of the hydraulic cylinder and piston assembly pivotably connected to the foot blade. EX1012, Fig. 1, 4:30-39; EX1010 at 6:52-54; EX1005 at ¶49-52.

Regarding the limitation of a "cushioning device" (claim 5) and the dorsi-flexion limiter including a "resilient elastomeric pad" (claim 8), *Mortensen* teaches a "resilient O-ring 120 disposed floating between piston 41 and sleeve 32 to absorb any force between the two members when they come in contact." EX1012 at 4:13-15. The sleeve is part of an end of the hydraulic cylinder 16 proximate the pivot end 51 of piston rod 18. *See id.* at Fig. 2; 2:31-32 ("[t]he crank end of the cylinder has a sleeve 32").

A POSA, reading *Mortensen*'s teachings that the O-ring 120 is resilient and absorbs force from mechanical contact, would have understood that the resilient O-ring 120 is a cushioning structure that increases resistance to the piston's 41 movement towards an end of the hydraulic cylinder 16. *Id.*, Fig. 2, 4:13–15; EX1005 at ¶61-62. As the piston 41 moves toward the end of the hydraulic cylinder 16 and causes contact between the O-ring 120 and the sleeve 32, the O-ring 120 functions to increase resistance to the piston's 41 movement because it resiliently absorbs the force applied by the piston 41 on the sleeve 32. *Id.*

c. ***Rationale for Combining Koniuk and Mortensen***

Although the damping means illustrated in Fig. 3 of *Koniuk* includes two hydraulic cylinders, *Koniuk* expressly discloses that, "[a]lternately, a single hydraulic cylinder may be employed." EX1010 at 9:20-23. *Koniuk* explicitly teaches that the single hydraulic cylinder includes "a plurality of internal pressure chambers 58, further having required fluidic couplings, through which the flow rate of fluid can be set to at least two levels." *Id.* at 9:23-26. Nevertheless, to the extent the Board concludes that *Koniuk* does not expressly disclose a linear piston and cylinder assembly, it certainly suggests such a structure, and a POSA would have known how to implement this structure based on *Mortensen*.

Mortensen expressly discloses a prosthetic device with a single, linear hydraulic cylinder with a plurality of internal regions and fluid passageways to control the flow rate of fluid between the regions. *See* § VII.1.b., *supra*. Hence, it would have required only routine effort for a POSA to incorporate the teachings of *Mortensen*'s single, linear hydraulic cylinder and piston with *Koniuk*'s disclosure to arrive at a prosthetic ankle and foot apparatus including a damping means with a single, linear hydraulic cylinder and piston, especially since *Koniuk* specifically suggests such a structure. EX1010 at 9:20-26; EX1005 at ¶¶37, 57. Consistent with *Koniuk*'s teachings, the end walls of the single, linear hydraulic cylinder would be mechanical end-stops that limit the pivoting or flexing of the attachment portion 34 relative to the foot blade 14. *See* § VII.1.a., *supra*; EX1005 at ¶¶32-35. There would have been nothing unpredictable or unexpected regarding developing a damping means with a single, linear hydraulic cylinder and piston because *Koniuk* explicitly suggests a prosthetic ankle and foot apparatus with such a damping means. EX1010 at 9:20-26; EX1005 at ¶¶58-60.

Likewise, *Koniuk* and *Mortensen* both teach fluid passageways and a valve system to control hydraulic fluid flow between regions of a single hydraulic cylinder. *See* EX1010 at 6:60-67, 9:23-26; EX1012 at Abstract. *Koniuk* specifically suggests that *any* flow control mechanism "known to skilled persons" can be used to control the flow of fluid through transfer conduit 64. EX1010 at 7:1–3. Hence, it would have required only routine effort for a POSA to incorporate *Mortensen*'s valve system having two separately adjustable valves coupled with a single, linear hydraulic cylinder and piston assembly. EX1005 at ¶59–60. There would have been nothing unpredictable or unexpected in controlling fluid flow and adjusting resistance in this manner because *Koniuk* explicitly suggests that *any* prior art means can be used. EX1010 at 9:20-26; EX1005 at ¶60. Indeed, other prior art references teach using mechanisms to control the fluid flow and adjust the resistance in two directions for prosthetic lower-limb devices. *See, e.g.*, EX1013 (*Lang*).

And a POSA would have been motivated, with a reasonable expectation of success, to incorporate the resilient O-ring 120 described in *Mortensen* to the single, linear hydraulic cylinder and piston assembly of the modified *Koniuk* prosthetic ankle and foot apparatus 10, for absorbing contact forces between the piston and an end of the hydraulic cylinder. EX1012 at 4:13–15; EX1005 at ¶61–62. Under *Mortensen*, a POSA would have recognized to dispose the resilient O-ring 120 on a surface of the piston facing the end of the cylinder proximate the pivot end of the piston rod, to resiliently absorb contact between the piston and the cylinder. *Id. Mortensen*'s resilient O-ring 120 incorporated with the single, linear hydraulic cylinder and piston assembly would increase resistance to the pivoting or flexing of *Koniuk*'s attachment portion 34 as it reaches the pivot or flexion limit towards the front portion 14a of the foot blade 14 (i.e., dorsi limit), and would prevent trauma, wear, and sudden step-changes in gait. EX1005 at ¶61-62.

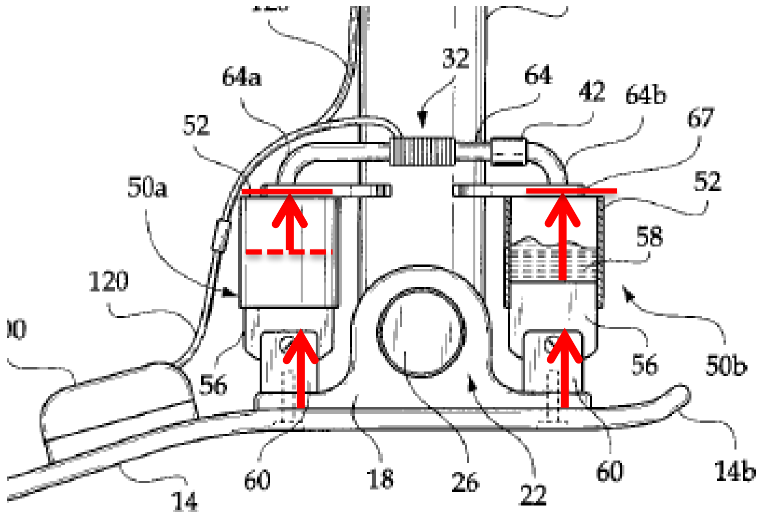
Thus, the combination of *Koniuk* and *Mortensen* would have rendered obvious claims 1 and 3-8, as shown in the charts below.

Independent Claim 1	**Citations in *Koniuk* and *Mortensen***
[1.0] A prosthetic foot and ankle assembly comprising a combination of:	*Koniuk* (EX1010), Fig. 3; Abstract ("An auto-adjusting *prosthetic ankle apparatus* includes . . . a *foot blade*.") (emphasis added).
[1.1] a foot component; and	EX1010 at 6:4-10 ("[T]he prosthetic ankle apparatus 10 may include a lower base portion 18 . . . structured for accepting and having a *foot blade* 14 fixed thereto.") (emphasis added).
[1.2] an ankle joint mounted to the foot component and having a fixed range of dorsi-plantar flexion during walking, the ankle joint comprising a joint mechanism providing resistance to ankle flexion, wherein the joint mechanism comprises:	EX1010 at 2:30-37 ("The attachment portion is pivotally fixed to the base portion, thereby enabling a pivoting or pivoting motion between the base portion, and items such as a foot blade that may be fixed thereto, with respect to the attachment portion. *For example, a pivoting motion may include a range of plus/minus 10 to 30 degrees*, and may enable a pivoting to any selected position between a first position and a second position.") (emphasis added). *Id.* at 3:35-41 ("The terms 'ankle' or 'ankle joint' . . . may . . . include[e] a base portion structured for accepting and being fixed to a foot blade, an attachment portion structured for fixing to a lower portion of a prosthetic limb/leg, and a . . . pivot arrangement enabling a pivoting motion between the base portion and the attachment portion."). *Id.* at 4:41-48 ("The terms 'dynamically controlled damping level' and 'damping level' are to be understood to indicate that, in real-time, a level of *damping applied resisting motion between the base portion and the attachment portion* can be changed, most preferably in a rapid, step-wise manner. As such, the damping is not fixed and will assume one of a plurality of available damping

	levels, each applied for differing portions of a walk cycle.") (emphasis added). *Id.* at 6:23-33 ("A dynamically controllable damping means is included that is structured to enable a damping level to be established that affects the pivoting of the ankle apparatus 10, which is preferably directly and functionally coupled between the base portion 18 and the attachment portion 34. The dynamically controlled damping means 48, as shown in FIGS. 3 and 4, selectively enables a level of *damping applied to a relative motion between the base portion 18 and the attachment portion 34 to be established at one of a first* damping level or a second damping level, or possibly any level therebetween.") (emphasis added).
[1.3] a hydraulic linear piston and cylinder assembly having a piston which is movable so as to define a pair of variable-volume chambers, one chamber located on each side of the piston and which is constructed and arranged to provide hydraulic damping continuously over the range of dorsi-plantar flexion, and	*Koniuk* (EX1010) at 6:43-45 ("[F]luid is transferred from one hydraulic cylinder to a second by way of [the] fluidic coupling."); 7:66-8:3 ("[E]ach of the first hydraulic cylinder 50a and the second hydraulic cylinder 50b includes a hydraulic cylinder casing 52. Each hydraulic cylinder casing 52 is structurally coupled to the attachment portion 34."). *Id.* at 9:23-28 ("Alternately, a single hydraulic cylinder may be employed (not illustrated) having a plurality of internal pressure chambers 58, further having required fluidic couplings, through which the flow rate of fluid can be set to at least two levels, enabling the establishing of a first damping level and a second damping level."). *Mortensen* (EX1012) at Abstract ("[A] hydraulic knee control for a prosthetic leg has a cylinder and piston . . . . Disposed outside of the cylinder are two bypass passageways wherein one end of each passageway communicates with the cylinder in the

	region between the piston and crank end and the other end of each passageway communicates with the cylinder in the region between the piston and the floating plug. One of the passageways has a one-way adjustable valve which allows the liquid to move only from the head end to the crank end in a controlled manner, and the other passageway has a one-way adjustable valve which allows the liquid to move only from the crank end to the head end in a controlled manner."); *see also* EX1005 at ¶44-46.
[1.4] a valve arrangement controlling the flow of hydraulic fluid between said chambers,	*Koniuk* (EX1010) at 6:60-7:3 ("[A]ny arrangement that is structured to control a flow rate at which fluid may be transferred from a first internal chamber to a second internal chamber . . . may be employed to select a first damping level or a second damping level . . . [such as,] conventional damping control arrangements, including *piezo-type values [sic], pet-cock arrangements, and other flow control mechanisms available and known to skilled persons* . . ."). (emphasis added) *Mortensen* (EX1012) at Abstract ("[O]ne end of each passageway communicates with the cylinder in the region between the piston and crank end and the other end of each passageway communicates with the cylinder in the region between the piston and the floating plug. One of the passageways has a one-way adjustable valve . . . , and the other passageway has a one-way adjustable valve."); *see also* EX1005 at ¶¶38, 44-46.
[1.5] the valve arrangement comprising first and second adjustable valves respectively comprising first and second orifices each adjustable in area for independently presetting dorsiflexion damping	*Mortensen* (EX1012) at 3:11-13 ("Bypass well 82 controls the rate at which the leg extends itself and well 83 controls the rate at which the leg flexes."); 3:44-66 ("When the knee flexes or bends, piston 41 moves down into the cylinder 16 while urging oil out . . . . To control the rate of flow, head 113 is screwed into or out of well 83. . . . When the leg tends to extend, the piston 41 moves towards the

resistance and plantar-flexion damping resistance respectively	crank end, urging oil out . . . . To control this rate of oil flow, head 103 is screwed into or out of the well 82."); *see also* EX1005 at ¶¶44-48.
[1.6] such that during walking said first orifice is preset to provide hydraulic damping at a first setting whenever the ankle joint is flexed in a dorsi-flexion direction and said second orifice is preset to provide hydraulic damping at a second setting whenever the ankle joint is flexed in a plantar flexion direction,	*Mortensen* (EX1012) at 1:35-38 ("A primary object of this invention is . . . control for a leg prosthetic wherein the resistance of flexion is not the same as the resistance to extension."); *see also* Limitation [1.5] above.
[1.7] wherein the joint mechanism includes a first flexion limiter that limits dorsi-flexion of the joint mechanism to a dorsi-flexion limit and a second flexion limiter that limits plantar-flexion of the joint mechanism to a plantar flexion limit, thereby defining said fixed range of dorsi-plantar flexion, the first and second flexion limiters comprising mechanical abutments of the joint mechanism.	*Koniuk* (EX1010). The top ends of cylindrical casings 52 associated with cylinders 50a, 50b constitute a "dorsi-flexion limit" and a "plantar flexion limit" because pistons 56 contact the top ends of the cylindrical casings 52 when they reach the limits of dorsi and plantar flexion: *Id.* at 2:35-37 ("[A] pivoting motion may include a range of plus/minus 10 to 30 degrees, and may enable a pivoting to any selected position between a first position and a second position.")

	 *See also id.*, Fig. 3; EX1005 at ¶32-36.

Dependent Claim 3	
[3.1] A prosthetic foot and ankle assembly according to claim 1, wherein the joint mechanism defines a medial-lateral joint flexion axis, the linear piston and cylinder assembly has a central axis, and the medial-lateral joint flexion axis is located to an anterior of the central axis of the linear piston and cylinder assembly.	*Koniuk* (EX1010) at 6:52-54 (A "hydraulic cylinder 50b [] positioned behind the attachment portion 34, closer to a heel portion of an attachable foot blade 14."). *Mortensen* (EX1012) at Fig. 1; 4:30-39 ("A leg prosthetic comprising: an upper thigh member; a lower shank member; a knee joint pivotably connecting said members; and first means pivotably connected between said members for control of said knee joint and comprising: a cylinder . . . ; a piston slidably disposed within said cylinder."); *see also* EX1005 at ¶49-52.

Dependent Claim 4	
[4.1] A prosthetic foot and ankle assembly according to claim 1, wherein said joint mechanism includes a first passage and a second passage, each passage being in communication with each of said chambers of the piston and cylinder assembly, said first passage containing said first adjustable	*Mortensen* at Abstract ("One of the passageways has a one-way adjustable valve . . . , and the other passageway has a one-way adjustable valve."); 3:44-48 ("When the knee flexes or bends, piston 41 moves down into the cylinder 16 while urging oil out of apertures 86, 86', 87, and 87'. . . . [A]s the oil tends to

valve and a first non-return valve and said second passage containing said second adjustable valve and a second non-return valve, said first non-return valve being oriented to prevent the flow of fluid between said chambers through said first passage in a first direction and said second non-return valve being oriented to prevent the flow of fluid between said chambers through said second passage in a second direction.	flow into apertures 86 and 86', sleeve 101 is urged against pin 102, blocking any flow of oil."); 3:56-62 ("When the leg tends to extend, the piston 41 moves towards the crank end, urging oil out of the apertures 84 and 85. . . . [W]hen oil is moving from cylinder 16 into the well 83 through aperture 85, pin 111 is urged against the shoulder formed by the reduced portion therein, thereby blocking oil flow."); *see also* EX1005 at ¶¶53-54.

Dependent Claim 5	
[5.1] A prosthetic foot and ankle assembly according to claim 1, the assembly including a cushioning device for increasing resistance to dorsi-flexion as flexion of the ankle joint approaches said dorsi-flexion limit.	*Mortensen* (EX1012) at Fig. 2; 2:31-32 ("The crank end of the cylinder has a sleeve 32."); 4:13-15 (A "resilient O-ring 120 disposed floating between piston 41 and sleeve 32 to absorb any force between the two members when they come in contact."); *see also* EX1005 at ¶¶55-56.

Dependent Claim 6	
[6.1] A prosthetic foot and ankle assembly according to claim 1, wherein the joint mechanism is non-electronically controlled and the hydraulic damping provided by the hydraulic linear piston and cylinder assembly is non-electronically controlled.	*See* Limitations [1.4]-[1.5] above. Both *Koniuk* and *Mortensen* disclose non-electronically controlled damping.

Dependent Claim 7	
[7.1] A prosthetic foot and ankle assembly according to claim 1, wherein the joint	*Koniuk* (EX1010) at Abstract ("The damping mechanism enables a damping level to be selectively applied to lightly damp or heavily damp a relative motion between the base portion and the attachment portion as a user is walking."). *Id.* at 6:34-60 ("[T]he dynamically controllable damping means 48 will include a hydraulic system including one or more hydraulic cylinders providing a plurality of hydraulically

mechanism is constructed and arranged such that during walking said resistance to ankle flexion is predominantly provided by hydraulic damping in one or both of the dorsi- and plantar-flexion directions.	coupled internal pressure cylinders. A most preferred form of damping is realized by a dynamically controlled damping of a pivoting motion of the ankle that simply controls a rate of flow of fluid that is transferred from a first internal pressure chamber 58 to a second internal pressure chamber. . . . As such, *when the attachment portion 34 is pivoted in a counter clockwise direction, fluid is transferred from a first hydraulic cylinder 50a,* which is positioned in front of the attachment portion 34 and closer to a front portion of an attachable foot blade 14. The fluid transferred from the first hydraulic cylinder 50a is coupled to a second hydraulic cylinder 50b that is positioned behind the attachment portion 34, closer to a heel portion of an attachable foot blade 14. *Similarly, fluid is transferred in the opposite direction, from the second hydraulic cylinder 50b to the first hydraulic cylinder 50a as the attachment portion 34 is pivoted in a clockwise direction*. It must be noted that such a structure enables a damping level to be established by simply altering the resistance to fluid flow through a fluid transfer conduit 64.") (emphases added); *see also* EX1005 at ¶40.

Independent Claim 8	
[8.0] A prosthetic foot and ankle assembly comprising a combination of:	*See* Limitation [1.0] above.
[8.1] a foot component, and	*See* Limitation [1.1] above.
[8.2] an ankle joint mounted to the foot component and having a fixed range of dorsi-plantar flexion, the ankle joint comprising a joint mechanism providing resistance to ankle flexion, wherein the joint mechanism comprises:	*See* Limitation [1.2] above.
[8.3] a hydraulic linear piston and cylinder assembly having a cylinder and a piston, the chamber having a pair of end walls and the piston being movable between the end walls so as to define a pair of variable-volume chambers, one chamber located on each side of the piston and which is constructed and arranged to provide hydraulic damping continuously over the range of dorsi-plantar flexion, and	*See* Limitations [1.3] and [1.7] above.
[8.4] a valve arrangement controlling the flow of hydraulic fluid between said chambers,	*See* Limitation [1.4] above.
[8.5] the valve arrangement comprising first and second	*See* Limitation [1.5]

adjustable valves respectively comprising first and second orifices each adjustable in area for independently presetting dorsiflexion damping resistance and plantar-flexion damping resistance respectively	above.
[8.6] such that said first orifice is preset to provide hydraulic damping at a first setting whenever the ankle joint is flexed in a dorsi-flexion direction and said second orifice is preset to provide hydraulic damping at a second setting whenever the ankle joint is flexed in a plantar-flexion direction,	*See* Limitation [1.6] above.
[8.7] wherein the joint mechanism includes a flexion limiter that limits dorsi-flexion of the joint mechanism to a dorsi-flexion limit, the flexion limiter comprising a resilient elastomeric pad on a chamber end wall or on a face of the piston.	*See* Limitation [1.7] and [5.1] above.

2. Ground 2: Claim 2 Is Rendered Obvious Under 35 U.S.C. § 103(a) by *Koniuk* in View of *Mortensen* and *Hellberg*.

To the extent *Koniuk* does not explicitly disclose a "pyramid alignment interface" as recited in claim 2, *Hellberg* (EX1014) supplies this teaching. *Hellberg* was published on June 4, 2002, and is prior art to the '991 patent under § 102(b). *Hellberg* was not cited in prosecution. EX1004.

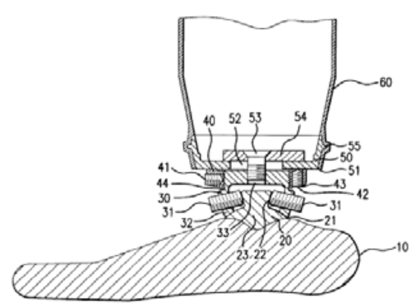


FIG.2

Hellberg relates to "an adjustment device for an artificial arm or leg." EX1014 at 1:9-10. *Hellberg* recognizes the importance of the prosthesis "be[ing] adjusted in both the angular and translatory direction, so that the user does not apply load in an unnatural way to the prosthesis." *Id.* at 1:19-22. In one embodiment (Fig. 2, reproduced above), *Hellberg* discloses an artificial foot 10 and a pyramid adapter

20 coupling the artificial foot 10 with a lower leg prosthesis sleeve 60 having an axis. *See also id.* at 3:48-54, 4:44-47. Based on these teachings, a POSA would understand that *Hellberg*'s pyramid adapter 20 adjusts the tilt of the lower leg prosthesis sleeve 60 to any appropriate angle relative to the artificial foot 10, for a user to properly apply load to the prosthesis. EX1005 at ¶¶64-68.

a. *Rationale for Combining* Koniuk *with* Hellberg

It would have been routine for a POSA to modify the *Koniuk* apparatus 10 such that its prosthetic limb clamp 30 includes a pyramid adapter 20 to attach to a lower leg prosthesis sleeve 60 having an axis and adjust the angular orientation of the lower leg prosthesis relative to the foot blade 14, as disclosed by *Hellberg*. EX1014 at 1:19-22; EX1005 at ¶¶66-71. There would have been nothing unpredictable or unexpected in developing the claimed pyramid alignment interface allowing adjustment of the shin component axis in the anterior and posterior directions relative to the foot component because the '991 patent itself recognizes that such an interface was conventional and well known to POSAs. EX1003 at 2:66-3:2 ("[a]djustment of the shin axis orientation in the anterior-posterior direction with respect to the foot component may be performed using at least one *conventional pyramid alignment interface*, preferably the shin component interface"); *id.* at 6:53-59 ("The shin connection interface 20 is *conventional*, being of pyramid construction. Typically, a tubular shin component is mounted to the shin connection interface 20, . . . as *well known to those skilled in the art*, for adjusting the orientation of the shin component.") (emphases added); EX1005 at ¶¶70-71. Thus, the combination of *Koniuk* and *Hellberg* teaches the elements of claim 2, rendering this claim unpatentable under § 103(a).

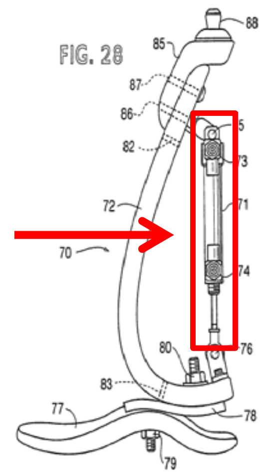
3. Ground 3: Claims 1-9 Are Rendered Obvious under 35 U.S.C. § 103(a) by *Townsend* in View of *Mortensen.*

a. Townsend *Discloses Nearly Every Limitation of Claims 1-9*

Townsend (EX1011) was published on September June 17, 2004, and is therefore prior art to the '991 patent under § 102(b). During prosecution, the Examiner relied on *Townsend* as a secondary reference to teach "a medial-lateral joint flexion axis anterior to a central axis of a shin axis," to "approximate the natural orientation of medial-lateral flexion of a natural human foot, to closely mimic a natural subtalar joint and result in more comfortable ambulation for the user." EX1004 at 73. Applicants never contested that finding.

Claims 1-9 of the '991 patent require a "prosthetic foot and ankle assembly" comprising a "foot component" and an "ankle joint . . . having a fixed range of dorsi-plantar flexion." These claims further require "a hydraulic linear piston and cylinder assembly [with] a pair of variable-volume chambers . . . arranged to provide hydraulic damping continuously over the range of dorsi-plantar flexion." *Townsend* satisfies these limitations because it discloses a prosthetic foot/ankle and a two-way adjustable hydraulic piston-and-cylinder assembly 71 that "limits the extent of the motion" the prosthesis undergoes during gait. EX1011 at Abstract. Joint mechanism 71 is a hydraulic linear piston and cylinder assembly with variable-volume chambers on either side of the piston, which provides hydraulic damping continuously over the range of motion. *See* EX1011 at [0007].

Claims 1-9 require "first and second adjustable valves . . . for presetting dorsi-flexion damping and plantar-flexion damping resistance respectively." *Townsend* discloses a two-valve, two-chamber adjustable cylindrical hydraulic piston, *see* EX1011 at Figs. 28-32; EX1005 at ¶¶74-76.



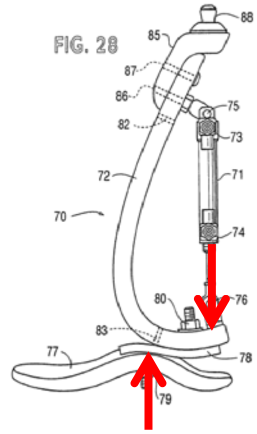
> The device has two variable controls, one for compression [plantar flexion], one for expansion [dorsi flexion], which permit adjustment of the permissible extent of the motion of the upper end of the calf shank in both compression and expansion of the calf shank in force loading and unloading.

EX1011 at [0095]. Device 71 leads to "improved dynamic response capabilities," *id.* at 15:10-13, and "the ability to 'tune'" the device creates "high gait efficiency and comfort," *id.* at 15:15-60. EX1005 at ¶83. The *Townsend* specification at paragraphs [0094]-[0101] describes various ways in which the hydraulic unit substantially dampens "the compression (plantar flexion) and expansion dorsiflexion" using "valves" which, "when nearly closed," force the unit's damping force "very high, making rapid walking and even running possible." *Id.* at [0098]. Accordingly, this limitation is satisfied.

Claims 1-7 require flexion limiters in the dorsi and plantar directions, and claim 8 requires a flexion limiter in the dorsi direction. Townsend satisfies these limitations because "dampening device 71 in the example embodiment of Figs. 28-32 limits the extent of the motion of the upper end of the calf shank in both compression [plantar-flexion] and expansion [dorsi-flexion] of the calf shank . . ." EX1011 at [0101]. More specifically, *Townsend* discloses a linear piston-and-cylinder assembly in which the internal plunger mechanically abuts the end walls of the cylinder 71 when the flexion limit is reached in both directions. *See id.* at Figs. 28, 30; *see also* EX1005 at ¶¶85-88.

Claims 2 and 9 require a "pyramid alignment interface allowing adjustment of a shin axis orientation." *Townsend* includes a conventional pyramid-alignment interface for connecting the device to a user's shin or other types of conventional connections, 88 ("inverted pyramid-shaped attachment fitting), 92 ("alignment coupler device"), and for angling the calf shank to a desired adjustment angle. *See* EX1011 at Abstract, [0100] ("pyramid"), [0105] ("The top of the upper slide 98 of the device 92 has an inverted pyramid shaped fitting 101."). Accordingly, *Townsend* teaches this limitation. *See* EX1005 at ¶89.

Finally, claim 3 requires that "medial-lateral joint flexion axis is located to an anterior of the central axis of the linear piston and cylinder assembly," and claim 9 requires a pivotal connection that is "displaced in an anterior-posterior direction." *Townsend* discloses these limitations. *See* Fig. 28; EX1005 at 91-93.



b. ***Mortensen* Cures Any Deficiencies of *Townsend***

To the extent *Townsend* does not explicitly disclose certain limitations of claims 1-9, *Mortensen* supplies these teachings, rendering claims 1-9 obvious under § 103(a). As explained, *Mortensen* teaches a single hydraulic cylinder and piston for controlling flexion and extension between two components of a prosthetic including two hydraulic passageways and an adjustable two-valve system for controlling the flow of hydraulic fluid between opposite regions in the hydraulic cylinder. *See* § VII.1., *supra*. Like *Townsend*, *Mortensen* discloses a mechanism of two hydraulic chambers in a single cylindrical piston that provides resistance to the ankle member pivoting or flexing relative to the heel or toe portion of the foot member. *See id.*; EX1005 at ¶¶99-101.

Regarding the requirement in claims 1-9 of two adjustable control valves, *Townsend* expressly discloses this feature, as explained above. Nevertheless, to the extent the Board concludes that this feature is not expressly taught in *Townsend*, it is certainly suggested in *Townsend* (*see* EX1011 at [0095] ("The device has two variable controls, one for compression, one for expansion . . .")), and a POSA would know how to implement this feature from *Mortensen*. EX1005 at ¶¶102-111. The adjustable two-valve system has already been discussed above in § VII.B, *supra*.

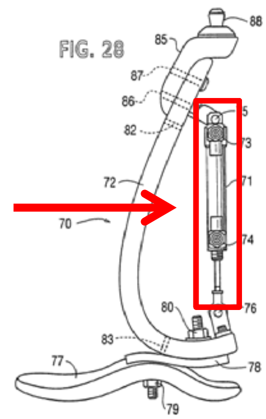
With respect to the "resilient elastomeric pad" in claim 8, *Mortensen* teaches a "resilient O-ring 120 disposed floating between piston 41 and sleeve 32 to absorb any force between the two members when they come in contact." EX1012 at 4:13-15. A POSA, reading *Mortensen*'s teachings that the O-ring 120 is resilient and absorbs force from mechanical contact, would understand that the O-ring 120 is a cushioning structure that increases resistance to the piston's 41 movement towards the crank end of the hydraulic cylinder 16. EX1005 at ¶¶112-113.

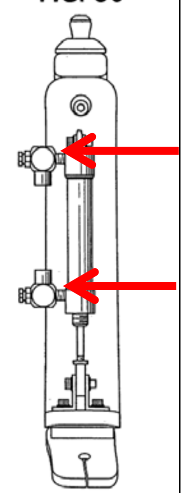
c. Rationale for Combining *Mortensen* and *Townsend*

A POSA would have been motivated, with a reasonable expectation of success, to combine the hydraulic linear two-chamber piston with the separate bypass adjustable valve system of Mortensen with the hydraulic linear two-chamber piston of *Townsend*, *see* § VII.c, as was widely accepted in the prior art as a means to improve *Townsend*. *See* EX1016 at 34 (suggesting "providing separate bypass tubes or passages and independently adjustable valves for controlling flexion and extension" in lower-limb prostheses). EX1005 at ¶¶114-116. It would also have been obvious to incorporate the resilient O-ring 120 described in *Mortensen* to the *Townsend* linear hydraulic cylinder and piston assembly 71, for absorbing contact forces between the piston and end of the hydraulic cylinder 71. EX1005 at ¶¶117-119. Under *Mortensen*'s teachings, a POSA would have recognized to dispose the resilient O-ring 120 on the faces of *Townsend's* pistons to resiliently absorb contact between the piston 18 and the ring wall 25. EX1005 at ¶117. *Mortensen*'s resilient O-ring 120 incorporated with *Townsend's* hydraulic cylinder 24 and piston 18 would increase resistance to the pivoting or flexing of the leg prosthesis 2 as it reaches the flexion limit, and would prevent trauma, wear, and sudden step-changes in gait. EX1005 at ¶118.

As shown, claims 1-9 are obvious over *Townsend* in view of *Mortensen*.

Independent Claim 1	***Townsend* & *Mortensen***
[1.0] A prosthetic foot and ankle assembly comprising a combination of:	*Townsend* (EX1011) at [0005] ("The prosthetic foot of the present invention."); *id.* at [0009] ("a foot keel and calf shank of a prosthetic foot").
[1.1] a foot component; and	*Townsend* (EX1011) at [0096] ("foot keel 77"); *id.* at [0075] ("foot keels 2, 33, 38, 42, and 43.").
[1.2] an ankle joint mounted to the foot component and having a fixed range of dorsi-plantar flexion during walking, the ankle joint comprising a joint mechanism providing resistance to ankle flexion, wherein the joint mechanism comprises:	*Townsend* discloses ankle joint 70; *id.* at cl 1 ("ankle joint area,") *id.* at cl. 24 ("ankle coupler"). *Townsend* (EX1011) at [0007] ("The prosthetic foot can also include a device to limit the extent of the motion of the upper end of the calf shank in response to force loading and unloading the calf shank during use of the prosthetic foot.).
[1.3] a hydraulic linear	*Townsend* (EX1011) at [0007] ("In one embodiment,

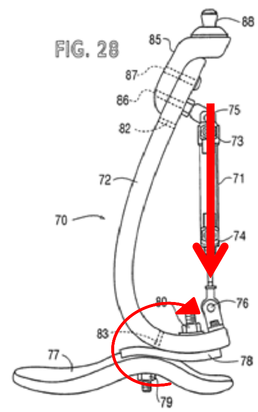
piston and cylinder assembly having a piston which is movable so as to define a pair of variable-volume chambers, one chamber located on each side of the piston and which is constructed and arranged to provide hydraulic damping continuously over the range of dorsi-plantar flexion, and	the device is a piston-cylinder unit connected between the upper and lower ends of the calf shank and containing at least one pressurized fluid to limit the extent of motion and also dampen the energy being stored or released during calf shank compression and expansion.”).  *Id.* at [0095] (“The device 71 in the example embodiment is a two-way acting piston cylinder unit in which pressurized fluids, a gas such as air or a hydraulic liquid, are provided through respective fittings 73 and 74. The device has two variable controls, one for compression, one for expansion, which permit adjustment of the permissible extent of the motion of the upper end of the calf shank in both compression and expansion of the calf shank in force loading and unloading.”).
[1.4] a valve arrangement controlling the flow of hydraulic fluid between said chambers,	*Townsend* (EX1011) at [0095] (“The device 71 in the example embodiment is a two-way acting piston cylinder unit in which pressurized fluids, a gas such as air or a hydraulic liquid, are provided through respective fittings 73 and 74. *The device has two variable controls, one for compression, one for expansion, which permit adjustment of the permissible extent of the motion . . .*”) (emphasis added). *Mortensen* (EX1012) at Abstract (“[A] hydraulic knee control for a prosthetic leg has a cylinder and piston assembly. In addition, within the cylinder is disposed a free floating plug so that the space between the free plug and the head end is filled with air or a compressible fluid, and the spaces between the free plug and the crank end is filled with a liquid or hydraulic fluid. The piston is disposed within this liquid and has sealing means which prevents the

	liquid from bypassing therearound. Disposed outside of the cylinder are two bypass passageways wherein one end of each passageway communicates with the cylinder in the region between the piston and crank end and the other end of each passageway communicates with the cylinder in the region between the piston and the floating plug.”). *Id.* at 1:35-38 (“A primary object of this invention is to provide a hydraulic knee control for a leg prosthetic wherein the resistance of flexion is not the same as the resistance to extension.”).
[1.5] the valve arrangement comprising first and second adjustable valves respectively comprising first and second orifices each adjustable in area for independently presetting dorsiflexion damping resistance and plantar-flexion damping resistance respectively	*Townsend* (EX1011), at [0095] (“The device 71 in the example embodiment is a two-way acting piston cylinder unit in which pressurized fluids, a gas such as air or a hydraulic liquid, are provided through respective fittings 73 and 74. The device has two variable controls, 60 one for compression, one for expansion, which permit adjustment of the permissible extent of the motion of the upper end of the calf shank in both compression and expansion of the calf shank in force loading and unloading. The device 71 also dampens the energy being stored or released during calf 65 shank compression and expansion.”); *id.* at [0097] (“resistance for compression is adjusted independent of the expansion adjustments.”). FIG. 30 
[1.6] such that during walking said first orifice is preset to provide hydraulic damping at a first setting whenever the ankle joint is flexed in a dorsi-flexion direction and said second orifice is preset to provide hydraulic damping at a	*Townsend* (EX1011) at [0095] (“The device has two variable controls, 60 one for compression, one for expansion, which permit adjustment of the permissible extent of the motion of the upper end of the calf shank in both compression and expansion of the calf shank in force loading and unloading.”). *Mortensen* at Abstract (“Disposed outside of the cylinder are two bypass passageways wherein one

second setting whenever the ankle joint is flexed in a plantar flexion direction,	end of each passageway communicates with the cylinder in the region between the piston and crank end and the other end of each passageway communicates with the cylinder in the region between the piston and the floating plug. One of the passageways has a one-way adjustable valve which allows the liquid to move only from the head end to the crank end in a controlled manner, and the other passageway has a one-way adjustable valve which allows the liquid to move only from the crank end to the head end in a controlled manner.”).
[1.7] wherein the joint mechanism includes a first flexion limiter that limits dorsi-flexion of the joint mechanism to a dorsi-flexion limit and a second flexion limiter that limits plantar-flexion of the joint mechanism to a plantar flexion limit, thereby defining said fixed range of dorsi-plantar flexion, the first and second flexion limiters comprising mechanical abutments of the joint mechanism.	*Townsend* (EX1011) at [0094] (“The prosthetic foot 70 shown in FIGS. 28-32 . . . further includes a calf shank range of motion limiter.”). *Id.* at [0097] (“The device 71 is not limited to the described piston cylinder unit but could be another velocity control and/or motion limiting device.”). *Id.* at [0101] (“[T]he motion limiting, dampening device 71.”). *Id.* at claim 1: “a device extending between and connected to the upper and lower ends of the shank to dampen the motion and limit the extent of the upper end of the shank in at least one of compression and expansion.” Figure 28, 29, and 30 show physical mechanical abutments of hydraulic cylinder; Plunger hits bottom of cylinder 71. *See* EX1005 at 85-88.

Dependent Claim 2	
[2.1] A prosthetic foot and ankle assembly according to claim 1, having at least one pyramid alignment interface allowing adjustment of a shin axis orientation in an anterior-posterior direction with respect	*See Townsend* (EX1011) at [0100] (“A prosthetic socket attached to the amputee's lower leg stump is connected to the upper end of calf shank 72 via an adapter 85 secured to the upper end of the calf shank by fasteners 86 and 87 . . . *The adapter has an inverted pyramid-shaped attachment fitting 88 connected to an attachment plate attached to an upper surface of the adapter.* The pyramid fitting is received by a complementarily shaped socket-type fitting on the depending prosthetic socket for joining the prosthetic foot and prosthetic socket. This type of

to the foot component.	connection is shown in the embodiment of FIGS. 34-36.") (emphasis added).

Dependent Claim 3	
[3.1] A prosthetic foot and ankle assembly according to claim 1, wherein the joint mechanism defines a medial-lateral joint flexion axis, the linear piston and cylinder assembly has a central axis, and the medial-lateral joint flexion axis is located to an anterior of the central axis of the linear piston and cylinder assembly.	*Townsend* (EX1011) at [0096] ("The motion of the upper end of the calf shank 72 of the foot 70 in compression and expansion of the calf shank is depicted in FIG. 32. The generally parabola shape of the calf shank is such that the upper end of the calf shank can move longitudinally with respect to the foot keel 77 and lower end of the calf shank connected thereto, e.g., along direction A-A in FIGS. 5 and 32, with compression and expansion of the calf 10 shank in force loading and unloading thereof.").  FIG. 28

Dependent Claim 4	
[4.1] A prosthetic foot and ankle assembly according to claim 1, wherein said joint mechanism includes a first passage and a second passages, each passage being in communication with each of said chambers of the piston and cylinder assembly, said first passage containing said first adjustable valve and a first non-return valve and said second passage containing said second adjustable	*Townsend* (EX1011) at [0095] ("The device has two variable controls, 60 one for compression, one for expansion, which permit adjustment of the permissible extent of the motion of the upper end of the calf shank in both compassion and expansion of the calf shank in force loading and unloading. The device 71 also dampens the energy being stored or released during calf 65 shank compression and expansion." 14:55-67; The valve has passages that open and close; e.g., the valve is "fully opened during pre-swing" and the system "allows it to close the compression;" or "when the valves are nearly closed."). *Id.* at 15:30-50 ("resistance for compression is adjusted independent of the expansion adjustments."). *See Mortensen* (EX1012), at 3:46-56 ("[A]s the oil tends to flow into apertures 86 and 86', sleeve 101 is urged against pin 102, blocking any flow of oil. The oil can flow only through bypass well 83 and out of aperture 85 into the other side of piston 41. To control the rate of flow,

valve and a second non-return valve, said first non-return valve being oriented to prevent the flow of fluid between said chambers through said first passage in a first direction and said second non-return valve being oriented to prevent the flow of fluid between said chambers through said second passage in a second direction.	head 113 is screwed into or out of well 83. Whenever the head 113 is screwed into the well, the rate decreases because the lower or larger end of pin 111 is moved closer to the reduced diameter portion of the well. *When the head 113 is screwed out of the well, then obviously the rate of flow increases*.") *and id.* at 3:59-4:1-2 ("[W]hen oil is moving from cylinder 16 into the well 83 through aperture 85, pin 111 is urged against the shoulder formed by the reduced portion therein, thereby blocking oil flow therethrough. However, oil flows from cylinder 16 into well 82 through aperture 84 because the sleeve 101 is urged away from pin 102. To control this rate of oil flow, head 103 is screwed into or out of the well 82. Again, when the head 103 is screwed into the well, the rate of flow decreases because the inner end of pin 102 is moved closer to sleeve 101. *When the head 103 is screwed out of the well, then obviously the rate of flow increases*.") (emphases added).

Dependent Claim 5	
[5.1] A prosthetic foot and ankle assembly according to claim 1, the assembly including a cushioning device for increasing resistance to dorsi-flexion as flexion of the ankle joint approaches said dorsi-flexion limit.	*Townsend* discloses "Rubber or foam pads 53 and 54 are provided on the lower forefoot and hindfoot as cushions." *Townsend* (EX1011) at 7:55-58. *Mortensen* (EX1012) at 4:13-15 ("A resilient O-ring 120 is disposed floating between piston 41 and sleeve 32 to absorb any force between the two members when they come in contact.").

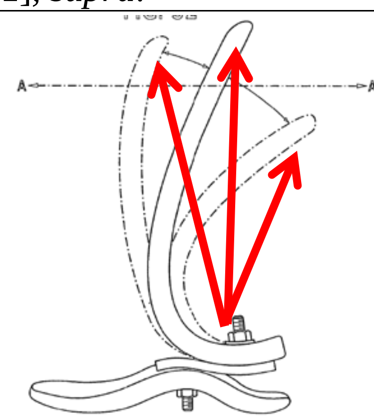
Dependent Claim 6	
[6.0] A prosthetic foot and ankle assembly according to claim 1, wherein the joint mechanism is non-electronically controlled and the hydraulic damping provided by the hydraulic linear piston and cylinder assembly is non-electronically controlled.	*See supra* Limitations [1.0-1.7], manually controlled.

Dependent Claim 7	
[7.0] A prosthetic foot and ankle assembly	*See* Limitations [1.0-1.7], *supra*.

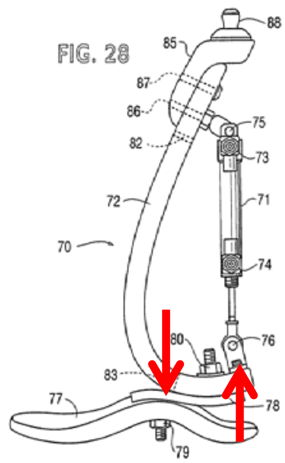
according to claim 1, wherein the joint mechanism is constructed and arranged such that during walking said resistance to ankle flexion is predominantly provided by hydraulic damping in one or both of the dorsi- and plantar-flexion directions.	*Townsend* (EX1011) at 14:63-68 ("The device 71 . . . has two variable controls, one for compression, one for expansion, which permit adjustment of the permissible extent of the motion of the upper end of the calf shank in both compression and expansion of the calf shank in force loading and unloading."). *Id.* at 15:45-50 ("When the valves are nearly closed, the unit dampening force becomes very high, making rapid walking and even running possible. The unique prosthesis-adjustable dynamic factor allows the hydraulic unit to be optimized for all gait patterns from slow to aggressive, fast gait speeds and movements.").

Independent Claim 8	
[8.0] A prosthetic foot and ankle assembly comprising a combination of:	*See* Limitation [1.0], *supra*.
[8.1] a foot component, and	*See* Limitation [1.1], *supra*.
[8.2] an ankle joint mounted to the foot component and having a fixed range of dorsi-plantar flexion, the ankle joint comprising a joint mechanism providing resistance to ankle flexion,	*See* Limitation [1.2], *supra*.
[8.3] wherein the joint mechanism comprises: a hydraulic linear piston and cylinder assembly having a cylinder and a piston, the chamber having a pair of end walls and the piston being movable between the end walls so as to define a pair of variable-volume chambers, one chamber located on each side of the piston and which is constructed and arranged to provide hydraulic damping continuously over the range of dorsi-plantar flexion, and	*See* Limitation [1.3], *supra*.
[8.4] a valve arrangement controlling the flow of hydraulic fluid between said chambers,	*See* Limitation [1.4], *supra*.
[8.5] the valve arrangement comprising first and second adjustable valves respectively comprising first and second orifices each adjustable in area for independently presetting dorsiflexion damping resistance and plantar-flexion damping resistance respectively	*See* Limitation [1.5], *supra*.
[8.6] such that said first orifice is preset to provide	*See* Limitation [1.6],

hydraulic damping at a first setting whenever the ankle joint is flexed in a dorsi-flexion direction and said second orifice is preset to provide hydraulic damping at a second setting whenever the ankle joint is flexed in a plantar-flexion direction,	*supra*.
[8.7] wherein the joint mechanism includes a flexion limiter that limits dorsi-flexion of the joint mechanism to a dorsi-flexion limit, the flexion limiter comprising a resilient elastomeric pad on a chamber end wall or on a face of the piston.	*Mortensen* (EX1012) at 4:13-15 ("A resilient O-ring 120 is disposed floating between piston 41 and sleeve 32 to absorb any force between the two members when they come in contact.").

Independent Claim 9	
[9.0] A prosthetic foot and ankle assembly comprising a combination of:	*See* Limitation [1.0], *supra*.
[9.1] a foot component, and	*See* Limitation [1.1], *supra*.
[9.2] an ankle joint pivotally mounted to the foot component at a first pivotal connection and having a fixed range of dorsiplantar flexion about the first pivotal connection,	Ankle joint 71 is connected pivotally at 76 and has a fixed range of dorsiplantar flexion about the first pivotal connection 76. *See Townsend* (EX 1011) at Fig. 32. 
[9.3] the ankle joint having a pyramid alignment interface for connection to a shin component defining a shin axis and for allowing adjustment of an orientation of the shin axis in an anterior-posterior direction with respect to the foot component,	*See* Limitation [2.1], *supra*.

[9.4] the ankle joint comprising a joint mechanism providing resistance to ankle flexion:	*See* Limitation [1.2], *supra*.
[9.5] wherein the joint mechanism comprises a hydraulic linear piston and cylinder assembly having a piston which is movable so as to define a pair of variable-volume chambers, one chamber located on each side of the piston and which is constructed and arranged to provide hydraulic damping continuously over the range of dorsi-plantar flexion, and	*See* Limitation [1.3], *supra*.
[9.6] a valve arrangement controlling the flow of hydraulic fluid between said chambers,	*See* Limitation [1.4], *supra*.
[9.7] the valve arrangement comprising first and second adjustable valves respectively comprising first and a second orifices each adjustable in area for independently presetting dorsiflexion damping resistance and plantar-flexion damping resistance respectively	*See* Limitation [1.5], *supra*.
[9.8] such that said first orifice is preset to provide hydraulic damping at a first setting whenever the ankle joint is flexed in a dorsi-flexion direction and said second orifice is preset to provide hydraulic damping at a second setting whenever the ankle joint is flexed in a plantar-flexion direction,	*See* Limitation [1.6], *supra*.
[9.9] wherein the pyramid alignment interface has a central axis which is substantially aligned with the central axis of the linear piston and cylinder assembly, and	*See* *Townsend* (EX1011) at [0073], [0105], Fig. 28; *see* § VII.3., *supra*.

[9.10] the linear piston and cylinder assembly is pivotally connected to the foot component at a second pivotal connection displaced in an anterior-posterior direction from the first pivotal connection, such that pivotal motion of the foot component relative to the ankle joint about the first pivotal connection causes the piston to move in the cylinder so as to provide hydraulic damping of ankle flexion.	 *Townsend* discloses a pivotally connected linear piston and cylinder assembly pivotally connected at a second pivotal connection 78/79/83 that is displaced in an anterior-posterior direction from the first connection 76. EX1011 at 15:3-11.

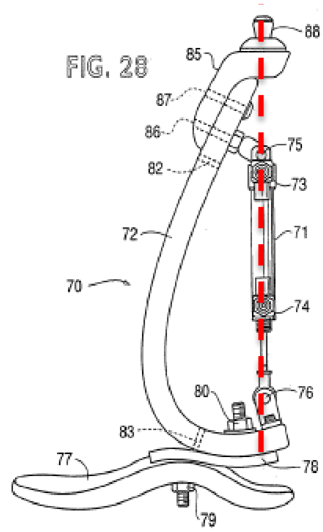
4. Ground 4: Claim 9 Is Rendered Obvious Under 35 U.S.C. § 103(a) by *Koniuk* in View of *Mortensen* and *Townsend*.

Claim 9 is similar to claim 3 except that it requires that “the pyramid alignment interface has a central axis which is substantially aligned with the central axis of the linear piston and cylinder assembly, and the linear piston and cylinder assembly is pivotally connected to the foot component at a second pivotal connection displaced in an anterior-posterior direction from the first pivotal connection . . .” EX1003 at Cl. 3, 9. To the extent the combination of *Koniuk* and *Mortensen* does not explicitly disclose this feature, *Townsend* does.

As explained above, *Townsend* teaches “an inverted pyramid-shaped attachment fitting 88” for coupling the prosthetic foot/ankle to a lower limb prosthesis. EX1011 at [0100]. The ’991 patent recognizes that interfaces like the pyramid-shaped attachment fitting 88 were conventional and commonplace to

POSAs for adjusting the shin axis orientation of a lower limb prosthesis in the anterior-posterior direction regarding the foot component. *See* § VII.2., *supra*. *Townsend* further describes that the fitting 88 includes a central axis substantially aligned with a central axis of the hydraulic device 71. *See* EX1011, Fig. 28 (annotated and reproduced here). *Townsend* teaches the linear piston and cylinder assembly 71 is pivotally connected to the foot at a first pivot connection 76, and the foot keel is connected at a second pivotal connection 78/79/83 displaced anterior (i.e., forward) to the first pivotal connection 76. Claim 9 further requires that "medial-lateral joint flexion axis is located to an anterior of the central axis of the linear piston and cylinder assembly." *Townsend* discloses these limitations, as shown in Figure 28.

FIG. 28



The '991 patent refers to the "conventional pyramid alignment interface," acknowledging it as commonplace. *See* § VII.2., *supra*. In both *Townsend*, *see* Fig. 28 (reproduced above), and *Koniuk*, *see* Fig. 3 (same), the pyramid fitting 88 to the shin rests directly above and in line with the central axis of the ankle mechanism. It would have been obvious to a POSA to replace *Koniuk*'s limb clamp 30 with a "conventional" pyramid alignment interface taught in *Townsend*, to attach a "complementary shaped socket-type fitting on the depending prosthetic socket."

EX1011 at [0100]; **EX1005 at ¶89; 120-126.** *Townsend* teaches that such a connection beneficially "allows for angular change-flexion/extension and abduction/adduction between the prosthetic socket and foot." EX1011 at [0105]. The arrangement of the pyramid fitting 88 substantially aligned with a central axis of the hydraulic device 71 purportedly is "useful in a prosthetic foot . . . where the wearer is to engage in activities such as running and jumping that generate forces . . . many times the wearer's body weight." *Id.* at [0094]. Thus, substituting such a connection would provide improved angular positioning of the lower leg prosthesis relative to the front or heel portion 14a, 14b of the foot blade 14 and increased support. *Id.* at [0094], [0105]; **EX1005 at ¶120-126.**

5. Ground 5: Claims 1 and 3-8 Are Rendered Obvious Under 35 U.S.C. § 102(b) by *Gramnas* in view of *Mortensen.*

a. **Gramnas** ***Discloses Most Limitations of Claims 1 and 3-8.***

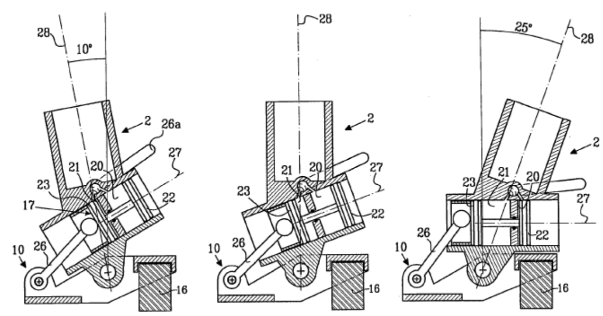


FIG.2a FIG.2b FIG.2c

Gramnas was published in the U.S. on March 4, 2004, and is prior art under 35 U.S.C. § 102(b). *Gramnas* was cited in an IDS of the '991 patent after examination was complete, just prior to allowance. EX1004 at 202.

Gramnas discloses an adjustable hydraulic ankle joint in which the range of motion is limited via a two-chamber hydraulic piston-and-cylinder assembly. The ankle joint mechanism continually provides resistance via “stepless” hydraulic damping in both the dorsi and plantar directions, EX1008. at [0013], in a range fixed by the mechanical limits of the linear, two-chamber hydraulic device between “about 10^o forwards from a vertical position . . .” and “25^o backwards from a vertical position.” *Id.* at [0017]; Fig. 2a-c.

Referring to Figure 1, *Gramnas* discloses a prosthetic leg 2 connected to a prosthetic foot 3 via pivot axle 4. *Id.* at [0012]. Lever arm 10 extends substantially parallel to the foot blade 7. *Id.* at [0014]. The front end 15 of lever arm 10 cooperates with “second means” 17, comprising a piston-and-cylinder mechanism, to “permit a stepless adjustment of the angle between the prosthesis and the foot in the initial position.” *Id.* at [0013]. The device will “limit a free rotatability between the leg prosthesis and the foot.” *Id.*

The “second means” 17 (i.e., the hydraulic ankle joint comprising piston-and-cylinder mechanism shown by items 18-25) operates in two modes. Specifically, “the second means 17 are arranged to take a first condition in which rotation between the lever arm 10 and the leg prosthesis 2 is permitted and a second condition in which an unrotatable connection is created between the lever arm 10 and the leg prosthesis 2.” *Id.* at [0015]. In this manner, ankle joint 17 can be set to allow hydraulically damped rotation in both directions, but can also be set to lock the foot in place at a desired angle relative to the leg, e.g., to facilitate walking up or down a slope. *See id.* at [0015], [0017]. Switching between these two modes is accomplished by "two-way valve 19 which in open position permits flow of medium between the chambers 20, 21 [of cylinder 24] and in closed position prevents such flow of medium." *Id.* at [0015].

When two-way valve 19 is open, "leg prosthesis 2 can be brought from a first extreme position in which the leg prosthesis is angled maximally forwards, which in one embodiment amounts to about 10^{o} forwards from a vertical position . . . to a second extreme position in which the leg prosthesis is angled maximally backwards, which in one embodiment amounts to about 25^{o} backwards from a vertical position . . ." *Id.* at [0017]. EX1005 at ¶¶134-142. The range of motion is fixed in the first mode of operation because piston 18 remains free to move in cylinder 24, with fluid continually exchanging through open valve 19 between chambers 20 and 21 on either side of the piston. *Id.* This provides continuous hydraulic damping in both the dorsi- and plantar directions during operation of the device in the first mode. EX1005 at ¶142. Hydraulic damping occurs because, during this range of motion, fluid is forced through the relatively small orifice illustrated in Figures 2a-2c. *See, e.g.,* EX1008 Figs.2a-2c; *see also* EX1005 at ¶141.

In this first mode of operation, i.e., when valve 19 is open, *Gramnas* satisfies the "hydraulic damping" limitation of claim 1 of the '991 patent, which requires that "the joint mechanism comprises a hydraulic linear piston and cylinder assembly" that "is constructed and arranged to provide hydraulic damping continuously over the range of dorsi-plantar flexion." EX1003 at Cl. 1. The limitation of claim 7, "wherein the joint mechanism is constructed and arranged such that during walking said resistance to ankle flexion is predominantly provided by hydraulic damping in one or both of the dorsi- and plantar-flexion directions," is likewise met because the *only* resistance to flexion provided by the ankle mechanism in *Gramnas* is hydraulic resistance. *See id.* at Fig.2c; EX1008 at [0015]; *see also* EX1005 at ¶¶147, 149.

Gramnas also satisfies the limitation in claim 3 that "the medial-lateral joint flexion axis is located to an anterior of the central axis of the linear piston and cylinder assembly." Specifically, *Gramnas* discloses that "cylinder 24 and the piston 18 are provided in the leg prosthesis above the pivot axle 4," and is "preferably arranged with a symmetry axis 27 making an angle with a longitudinal axis 28 of the leg prosthesis in the direction of the leg" where "[p]referably, the symmetry axis 27 crosses the foot blade 7 or close to a toe region of the foot blade 7." EX1008 at [0015]-[0016]. Based on these teachings, a POSA would understand that *Gramnas*' pivot axle 4 is positioned to the anterior of the central axis of the hydraulic cylinder and piston assembly. EX1005 at ¶152; *see also* EX1008 at Figs. 1 and 2c.

Regarding the requirement in claims 1 and 3-8 of flexion limiters, *Gramnas* discloses a hydraulic cylinder with a mechanical end-stop ring wall 25. *Id.* at [0025] ("said ring wall dividing the space between the ring flanges of the piston"). Ring flanges 22 and 23 (which make up piston 18) move in their respective chambers 20, 21 and physically abut ring wall 25 providing a mechanical end-stop for the hydraulically controlled range of motion around pivot axle 4, as shown in figs. 2a and 2c at the maximum and minimum dorsi-plantar flexion.

b. **Mortensen *Cures Any Deficiencies of* Gramnas**

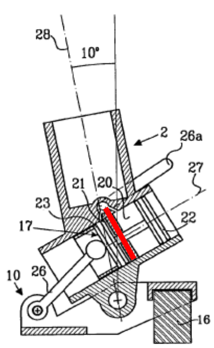
To the extent *Gramnas* does not explicitly disclose certain features recited in claims 1 and 3-8, *Mortensen* (EX1012) supplies these teachings. Like *Gramnas*, and as explained in Ground 1, *Mortensen* discloses a single, linear hydraulic cylinder and piston for controlling flexion of a prosthesis. *See* § VII.1.b., *supra*. *Mortensen* discloses two hydraulic passageways and a two-valve system for controlling the flow of hydraulic fluid between opposite regions in the hydraulic cylinder 16 caused by linear movement of the piston 41 within the cylinder 16: "a one-way adjustable valve which allows the liquid to move only from the head end to the crank end in a controlled manner, and . . . a one-way adjustable valve which allows the liquid to move only from the crank end to the head end in a controlled manner." EX1012 at Abstract. The one-way valves include adjustable heads 103, 113 that each individually control the hydraulic fluid flow between the opposite regions in the hydraulic cylinder 16 by screwing into and out of wells 82, 83 of the passageways, which controls the resistance and the rate at which the two components of the prosthesis flex or pivot relative to each other in a first and a second direction. EX1005 at ¶¶153-157.

c. ***Rationale for Combining* Gramnas *and* Mortensen**

Gramnas and *Mortensen* both teach fluid passageways and a valve system to control hydraulic fluid flow between regions of a single hydraulic cylinder. *See*, *e.g.*, EX1008 at [0015] and EX1012 at Abstract; *see also* §§ VII.1 and VII.3, *supra*. *Mortensen*'s valve system allows a user to control and adjust the resistance to relative flexion between two components of a lower-limb prosthesis for walking. *See* § V.4.a, *supra*; EX1005 at ¶¶153-157. *Gramnas* recognizes the desire for "[i]ndividual adaption of the foot [prosthesis]." EX1008 at [0003]. Consistent with these teachings, a POSA would have been motivated to incorporate the features of *Mortensen*'s two-valve system to the hydraulic mechanism of *Gramnas* for adapting the *Gramnas* prosthesis to a variety of users and applications. EX1005 at ¶¶166-167. A POSA would have been motivated to incorporate the *Mortensen* valve system to the *Gramnas* hydraulic mechanism to adapt the *Gramnas* prosthesis for users of varying weight by adjusting the resistance to ankle flexion, as taught by *Mortensen*, depending on the user's weight. *See* EX1009 at [0009] (*Christensen*, teaching that "prosthetic feet may require a high degree of custom design, or be particularly tailored to the individual user"); *see also* EX1005 at ¶¶166-167. In addition, a POSA would have been motivated to incorporate the *Mortensen* valve system to the *Gramnas* prosthesis for "individual adaption" of ankle flexion resistance depending on the user's activities. EX1005 at ¶167. There would have been nothing unpredictable or unexpected in incorporating the *Mortensen* valve system to the *Gramnas* hydraulic mechanism as both *Gramnas* and *Mortensen* teach a known system for hydraulically damping the flexion of two components of a prosthesis. *See* § VII.1.b, *supra*; EX1005 at ¶166. Thus, the *Gramnas* in view of *Mortensen* renders claims 1 and 3-8 obvious under § 103(a).

Independent Claim 1	***Gramnas* and *Mortensen***
[1.0] A prosthetic foot and ankle assembly comprising a combination of:	*Gramnas* (EX1008), at [0012] ("In FIG. 1 there is shown a prosthesis generally denoted 1.").
[1.1] a foot component; and	*Gramnas* (EX1008) at [0012] ("The prosthesis comprises a leg prosthesis 2 and *a foot 3*. . . . The foot 3 is also constructed in a manner well-known to the person skilled in the art . . .") (emphasis added).
[1.2] an ankle joint mounted to the foot component and having a fixed range of dorsi-plantar flexion during walking, the ankle joint comprising a joint mechanism providing resistance to ankle flexion, wherein the joint mechanism comprises:	*See* Limitation [1.1], *supra*. *Gramnas* EX1008) at [0015] (device is "*adapted to permit a limited rotation* of the foot 3 with respect to the leg prosthesis 2 from an initial position and the second end 15 is arranged to cooperate with second means 17 arranged to permit a stepless adjustment of the angle between the prosthesis and the foot in the initial position.") (emphasis added). *Id.* at [0013] (device will "*limit a free rotatability* between the leg prosthesis and the foot.") (emphasis

	added).
[1.3] a hydraulic linear piston and cylinder assembly having a piston which is movable so as to define a pair of variable-volume chambers, one chamber located on each side of the piston and which is constructed and arranged to provide hydraulic damping continuously over the range of dorsi-plantar flexion, and	*Gramnas* (EX1008), at [0015] ("In a preferred embodiment the displaceable element 18 consists of a piston 18 with outwardly projecting ring flanges 22, 23 and which is displaceable in a cylinder 24 attached to the leg prosthesis 2. The members 19, 20, 21 for the piston in a desired displaced position with respect to the cylinder 24 further comprise a ring wall 25 in the cylinder, said ring wall dividing the space between the ring flanges of the piston into two chambers 20, 21 and a two-way valve 19 which in open position permits flow of 30 medium between the chambers 20, 21.").
[1.4] a valve arrangement controlling the flow of hydraulic fluid between said chambers,	*Gramnas* (EX1008) at [0015] ("The two-way valve 19 is in a known manner adjustable between its first and second position by a control stick *26a* from the outside of the prosthesis."); *id.* ("[A] two-way valve 19 which in open position permits flow of 30 medium between the chambers 20, 21 and in closed position prevents such flow of medium"). *Mortensen* at Abstract ("One of the passageways has a one-way adjustable valve which allows the liquid to move only from the head end to the crank end in a controlled manner, and the other passageway has a one-way adjustable valve which allows the liquid to move only from the crank end to the head end in a controlled manner.").
[1.5] the valve arrangement comprising first and second adjustable valves respectively comprising first and second orifices each adjustable in area for independently	*Mortensen* (EX1012) at 1:35-38 ("[A] hydraulic knee control for a leg prosthetic wherein the resistance of flexion is not the same as the resistance to extension."). *Id.* at 3:46-56 ("[A]s the oil tends to flow into apertures 86 and 86', sleeve 101 is urged against pin 102, blocking any flow of oil. The oil can flow only through bypass well 83 and out of aperture 85 into the other side of

presetting dorsiflexion damping resistance and plantar-flexion damping resistance respectively	piston 41. To control the rate of flow, head 113 is screwed into or out of well 83. Whenever the head 113 is screwed into the well, the rate decreases because the lower or larger end of pin 111 is moved closer to the reduced diameter portion of the well. When the head 113 is screwed out of the well, then obviously the rate of flow increases.”).
[1.6] such that during walking said first orifice is preset to provide hydraulic damping at a first setting whenever the ankle joint is flexed in a dorsi-flexion direction and said second orifice is preset to provide hydraulic damping at a second setting whenever the ankle joint is flexed in a plantar flexion direction,	*Gramnas* (EX1008) at [0015] (“The two-way valve 19 is in a known manner adjustable between its first and second position by a control stick *26a* from the outside of the prosthesis.”). *Mortensen* (EX1012) at 3:11-13 (“[Bypass well 82 controls the rate at which the leg extends itself and well 83 controls the rate at which the leg flexes.”). *Id.* at 3:50-52 (“To control the rate of flow, head 113 is screwed into or out of well 83.”). *Id.* at 3:63-66 (“However, oil flows from cylinder 16 into well 82 through aperture 84 because the sleeve 101 is urged away from pin 102. To control this rate of oil flow, head 103 is screwed into or out of the well 82.”).
[1.7] wherein the joint mechanism includes a first flexion limiter that limits dorsi-flexion of the joint mechanism to a dorsi-flexion limit and a second flexion limiter that limits plantar-flexion of the joint mechanism to a plantar flexion limit, thereby defining said fixed range of dorsi-plantar flexion, the first and second flexion limiters comprising mechanical	*Gramnas* (EX1008) at [0013] (device will “limit a free rotatability between the leg prosthesis and the foot.”).  FIG.2a For dorsi- and plantar-flexion limiters, *see* ring wall 25: “The members 19, 20, 21 for the piston in a desired displaced position with respect to the cylinder 24 further comprise *a ring wall 25* in the cylinder, said ring wall dividing the space between the ring flanges of the piston into two chambers 20, 21 and a two-way valve 19 which in open position permits flow of 30 medium between the chambers 20, 21 . . .” *Id.* at [0015] (emphasis added).

abutments of the joint mechanism.	*Id.* at [0017] (". . . the leg prosthesis 2 can be brought from a first extreme position in which the leg prosthesis is angled maximally forwards, Which in one embodiment amounts to about 10° forwards from a vertical position, this position being shown in FIG. 2a, to a second extreme position in Which the leg prosthesis is angled maximally backwards, Which in one embodiment amounts to about 25° backwards from a vertical position.").

Dependent Claim 3	
[3.1] A prosthetic foot and ankle assembly according to claim 1, wherein the joint mechanism defines a medial-lateral joint flexion axis, the linear piston and cylinder assembly has a central axis, and the medial-lateral joint flexion axis is located to an anterior of the central axis of the linear piston and cylinder assembly.	*Gramnas* (EX1008) at [0015]-[0016] (the hydraulic "cylinder 24 and the piston 18 are provided in the leg prosthesis above the pivot axle 4," and is "preferably arranged with a symmetry axis 27 making an angle with a longitudinal axis 28 of the leg prosthesis in the direction of the leg"). *See also* EX1005 at ¶152.

Dependent Claim 4	
[4.1] A prosthetic foot and ankle assembly according to claim 1, wherein said joint mechanism includes a first passage and a second passages, each passage being in communication with each of said chambers of the piston and cylinder assembly, said first passage containing said first adjustable valve and a first non-return valve and said second passage containing said second adjustable valve and a second non-return valve, said first non-return valve being oriented to prevent the flow of fluid between said chambers through said first	*See* Limitations [1.0-1.7], *supra.* *Mortensen* (EX1012) at Abstract ("One of the passageways has a one-way adjustable valve which allows the liquid to move only from the head end to the crank end in a controlled manner, and the other passageway has a one-way adjustable valve which allows the liquid to move only from the crank end to the head end in a controlled manner."). *Id.* at 3:11-13 ("Bypass well 82 controls the rate at which the leg extends itself and well 83 controls the rate at which the leg flexes."); *id.* 3:44-66 ("When the knee flexes or bends, piston 41 moves down into the cylinder 16 while urging oil out . . . . To control the rate

passage in a first direction and said second non-return valve being oriented to prevent the flow of fluid between said chambers through said second passage in a second direction.	of flow, head 113 is screwed into or out of well 83. . . . When the leg tends to extend, the piston 41 moves towards the crank end, urging oil out . . . . To control this rate of oil flow, head 103 is screwed into or out of the well 82.”).

Dependent Claim 5	
[5.0] A prosthetic foot and ankle assembly according to claim 1, the assembly including a cushioning device for increasing resistance to dorsi-flexion as flexion of the ankle joint approaches said dorsi-flexion limit.	*See* Limitations [1.0-1.7], *supra*, in particular Limitation [1.7] (piston mechanical end and ring seal).

Dependent Claim 6	
[6.0] A prosthetic foot and ankle assembly according to claim 1, wherein the joint mechanism is non-electronically controlled and the hydraulic damping provided by the hydraulic linear piston and cylinder assembly is non-electronically controlled.	*See* Limitations [1.0-1.7], *supra*; *Gramnas* discloses only a manual hydraulic mechanism. *Gramnas* (EX1008), Abstract.

Dependent Claim 7	
[7.0] A prosthetic foot and ankle assembly according to claim 1, wherein the joint mechanism is constructed and arranged such that during walking said resistance to ankle flexion is predominantly provided by hydraulic damping in one or both of the dorsi- and plantar-flexion directions.	*See* Limitations [1.0-1.7], *supra*. The “second means” of *Gramnas* can provide dynamic, stepless rotation, hydraulically limiting “a free rotatability between the leg and prosthesis and the foot” during walking. *Gramnas* (EX1008) at [0013]. It uses a hydraulic two-chamber cylinder and stop limiters to provide a “limited rotation of the foot with respect to the leg prosthesis.” *See, e.g.*, *Gramnas* (EX1008) at Abstract; Fig. 1, 2a-2c. *See also* EX1005 at ¶¶142, 149, 151**.**

Independent Claim 8	
[8.0] A prosthetic foot and ankle assembly comprising a combination of:	*See* Limitation [1.0], *supra*.
[8.1] a foot component, and	*See* Limitation [1.1], *supra*.
[8.2] an ankle joint mounted to the foot	*See* Limitation [1.2], *supra*.

component and having a fixed range of dorsi-plantar flexion, the ankle joint comprising a joint mechanism providing resistance to ankle flexion,	
[8.3] wherein the joint mechanism comprises: a hydraulic linear piston and cylinder assembly having a cylinder and a piston, the chamber having a pair of end walls and the piston being movable between the end walls so as to define a pair of variable-volume chambers, one chamber located on each side of the piston and which is constructed and arranged to provide hydraulic damping continuously over the range of dorsi-plantar flexion, and	*See* Limitation [1.3], *supra*.
[8.4] a valve arrangement controlling the flow of hydraulic fluid between said chambers,	*See* Limitation [1.4], *supra*.
[8.5] the valve arrangement comprising first and second adjustable valves respectively comprising first and second orifices each adjustable in area for independently presetting dorsiflexion damping resistance and plantar-flexion damping resistance respectively	*See* Limitation [1.5], *supra*.
[8.6] such that said first orifice is preset to provide hydraulic damping at a first setting whenever the ankle joint is flexed in a dorsi-flexion direction and said second orifice is preset to provide hydraulic damping at a second setting whenever the ankle joint is flexed in a plantar-flexion direction,	*See* Limitation [1.6], *supra*.
[8.7] wherein the joint mechanism includes a flexion limiter that limits dorsi-flexion of the joint mechanism to a dorsi-flexion limit, the flexion limiter comprising a resilient elastomeric pad on a chamber end wall or on a face of the piston.	*Mortensen* (EX1012) at 4:13-15 (“A resilient O-ring 120 is disposed floating between piston 41 and sleeve 32 to absorb any force between the two members when they come in contact.”).

6. Ground 6: Claim 2 Is Rendered Obvious under 35 U.S.C. § 103(a) by *Gramnas* in View of *Mortensen* and *Hellberg*.

To the extent *Gramnas* does not explicitly disclose a "pyramid alignment interface," as recited in claim 2, *Hellberg* (EX1014) does, as explained in § VII.2, *supra*. It would have been obvious to combine the pyramid alignment interface of *Hellberg* with the prosthetic ankle mechanism of *Gramnas* for the reasons explained above in § VII.2.

7. Ground 7: Claim 9 Is Rendered Obvious Under 35 U.S.C. § 103(a) by *Gramnas* in View of *Mortensen* and *Townsend*.

To the extent *Gramnas* in view of *Mortensen* does not teach the "pyramid alignment interface" and "displaced in an anterior-posterior direction" limitations of claim 9, these features would have been obvious in view of *Townsend* for the reasons explained above in § VII.4.

VIII. CONCLUSION

Petitioner respectfully requests IPR and cancellation of claims 1-9 of U.S. Patent No. 8,740,991.

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CERTIFICATE OF SERVICE

I certify that on Monday, February 02, 2015, this Petition for *Inter Partes* Review of U.S. Patent No. 8,740,991 and Exhibits Nos. 1001-1030 were served via EXPRESS MAIL® on the following counsel of record for patent owner.

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