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PROSTHETIC FOOT

RELATED APPLICATIONS

This application is a continuation-in-part of application Ser. No. 10/790,177, filed Mar. 2, 2004, now U.S. Pat. No. 6,936,074 issued Aug. 30, 2005, which is a continuation of application Ser. No. 09/917,660, filed Jul. 31, 2001, now U.S. Pat. No. 6,743,260, issued Jun. 1, 2004, which is a continuation-in-part of application Ser. No. 09/742,077, filed Dec. 22, 2000, now U.S. Pat. No. 6,443,995, issued Sep. 3, 2002. This application is also a continuation-in-part of application Ser. Nos. 10/814,155 and 10/814,260, each filed Apr. 1, 2004, which are each:

a continuation-in-part of application Ser. No. 10/473,682, which is the U.S. national designated filing under 35 U.S.C. §371 of international application PCT/US02/09589 filed Mar. 29, 2002, which is a continuation-in-part of U.S. application Ser. No. 09/820,895, filed Mar. 30, 2001, now U.S. Pat. No. 6,562,075 issued May 13, 2003; and

a continuation-in-part of application Ser. No. 10/263,795 filed Oct. 4, 2002, which is a continuation of application Ser. No. 09/820,895, filed Mar. 30, 2001, now U.S. Pat. No. 6,562,075 issued May 13, 2003. The disclosures of these related applications are hereby incorporated by reference.

TECHNICAL FIELD

A prosthetic foot that mimics the human foot in function is disclosed. The prosthetic foot has hindfoot triplanar motion capability, biplanar midfoot and forefoot motion capabilities and high low dynamic response characteristics for improving gait and comfort qualities of the amputee in walking, running and jumping activities. An ankle pylon component providing hindfoot triplanar motion capability for upgrading an existing low profile prosthetic foot is also disclosed.

BACKGROUND AND SUMMARY

Those in the field of prosthetics have in the past manufactured prosthetic feet which permit varying degrees of motion capability. Most of the known prosthetic feet utilize metal hinges with rubber bumpers to enable this motion capability. These components are sources for mechanical failures and wear. The known prosthetic feet are also generally expensive to produce and maintain. None of the conventional prosthetic feet mimic human gait characteristics, e.g., while known designs allow some motion capability, the conventional prosthetic feet do not reflect humanoid characteristics. These characteristics relate to the biomechanical function of the human foot and ankle joint in gait. The prior art prosthetic feet have not achieved true human gait characteristics because their design features do not mimic the human foot.

The human foot is a complex comprised of twenty-six separate bones. The bones of the foot articulate with one another to create joints. The joints of the foot, through these articulations, allow movement to occur. The motion capability of a particular joint is dependent upon bony articulations, ligamentous reinforcements and muscular control. Motion capability of specific joints of the foot has been studied quite extensively through history. These scientific studies have identified fourteen different axes of rotations of all the joints of the human foot. They have through thoughtful analysis determined how these axes of rotations and motion capabilities function in human gait and running and

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jumping activities. The prosthetic foot of the present invention has been made in light of these scientific studies with a view toward providing an improved prosthetic foot that mimics the human foot in function in order to provide the amputee with normal human gait characteristics and improve the quality of life of the amputee.

A prosthetic foot according to the present invention comprises a forefoot portion, a midfoot portion and a hindfoot portion, wherein the hindfoot portion includes first and second joints permitting closed kinetic chain motion of the prosthetic foot in gait. The first joint has a joint axis oriented for permitting motion of the hindfoot portion about the first joint axis which is at least primarily in the sagittal plane. The second joint has a joint axis oriented for permitting motion of the hindfoot portion about the second joint axis which is at least primarily in the frontal and transverse planes. In the disclosed example embodiments, the first and second joints are formed integrally with the hindfoot portion by respective struts of resilient material of the hindfoot portion. More particularly, in one example embodiment the forefoot, midfoot and hindfoot portions of the prosthetic foot are formed of a single piece of plastic as by molding and/or machining.

In a second embodiment, the improved prosthetic foot of the invention is formed by use of an ankle pylon component of the invention which is attached to an existing low profile prosthetic foot as a functional upgrade. The ankle pylon component contains the first and second joints which form part of the hindfoot portion of the foot. In both embodiments, the first joint in the hindfoot portion mimics an ankle joint and the second joint mimics a subtalar joint to allow the foot to function like a normal foot.

The subtalar joint in the hindfoot portion of the disclosed embodiments constitutes a means for permitting triplanar closed kinetic chain motion of the prosthetic foot in gait. This triplanar motion capability improves the foot staying plantar grade during the stance phase of gait. It also decreases residual limb to socket shear forces associated with motion in the transverse plane.

These and other objects, features and advantages of the present invention will become more apparent from the following detailed description of the disclosed, example embodiments, taken with the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

The foregoing and a better understanding of the present invention will become apparent from the following detailed description of the example embodiments and the claims when read in connection with the accompanying drawings, all forming a part of the disclosure of this invention. While the foregoing and following written and illustrated disclosure focuses on several example embodiments of the invention, it should be clearly understood that the same is by way of illustration and example only and the invention is not limited thereto. The spirit and scope of the present invention are limited only by the terms of the appended claims.

The following represents brief descriptions of the drawings, wherein:

FIG. 1 is a perspective view, from the right front and slightly above, of a right prosthetic foot according to a first example embodiment of the invention.

FIG. 2 is a lateral side view of the prosthetic foot of FIG. 1 located within a cosmetic covering of the foot, shown in dashed lines, and in position for connection with an adjoining prosthesis on the amputee's leg, also shown in dashed lines.