

extending hole 42 for passage of pin 24. Front portion 38 includes a vertically extending hole 44 for insertion of a cylindrical plastic limiter 46 to further control compression of the front bumper. The bottom surface 48 of rear portion 40 is semi-circular for receipt of a threaded washer 50 positioned within the bottom portion of the housing and extending through hole 18.

Rear bumper 38, as also shown in FIGS. 2b, is generally U-shaped having a rounded rear portion 52 and two perpendicularly extending flanges 54. Flanges 54 include a horizontally extending hole 56 for passage of pin 24. Rear portion 52 includes a vertically extending hole 58 for a plastic cylindrical limiter 60 similar to limiter 46. The length of limiters 46 and 60 can be varied to adjust their function. When the front and rear bumpers are assembled within the housing, flange 40 of the front bumper extend between flanges 54 of the rear bumper such that holes 42 and 56 are aligned with holes 22 and 34 of the bottom and top portions of the housing, respectively.

The front bumper has a higher durometer hardness than the rear bumper such that the front bumper can act as a stop in the mid-stance position. The exact durometer hardness for both the front and rear bumpers can be varied depending upon the weight and activity level of the amputee. It is further contemplated that a number of rear bumpers having a variety of hardnesses would be supplied with the ankle joint so that the prosthetist can easily change the bumper depending upon the amputer's anticipated activity level. By way of a non-limiting example, the front bumper has a shore A 95 hardness and the rear bumper would include a set of bumpers having shore A 85, shore A 75, and shore A 60 hardnesses. Preferably, the bumpers would be color coded for their varying hardnesses.

The ankle joint is assembled by positioning the front and rear bumpers within the bottom portion of the housing, and the upper portion of the housing would be positioned on top of the bumpers such that flanges 32 would be positioned between flanges 54 of the rear bumper and flange 40 of the front bumper. Then pin 24 would be passed through axially aligned holes 22, 56, 34, and 42. To aid in insertion of the pin, a bullet-shaped adapter 62 can be threaded into the end of the pin to help align the holes through the flanges of the components. Once the pin has passed entirely through the ankle joint, the adapter 62 can be unscrewed and the threaded bolt 64 would be screwed into the end of the pin.

An assembled ankle joint is then positioned between a foot component 66 and a lower leg component 68 as shown in FIG. 3. The ankle joint 10 is attached to the lower leg component 68 such that the four angular sides of the boss 32 are contacted by separate set screws 70 which are carried at 90° intervals spaced apart around the bottom portion of the socket 72. In use, the boss 32 can be inserted into the socket 72, and the set screws can be loosened or tightened and the boss moved into various angular configurations for providing angular adjustments between the ankle joint and the lower leg component 68. The ankle joint is also connected to the foot component 66 by a bolt 74 which passes through a hole 76 in the bottom of the foot component and into the threaded washer 50 of the ankle joint. By making the ankle joint a separate component, it is universally adaptable between most manufacturer's foot components and lower leg components.

The multi-axis ankle joint of the present invention provides dynamic foot motion allowing the foot to articulate in multiple axes providing plantar flexion, dorsiflexion, inversion, eversion, and vertical shock absorption motion.

Although the present invention has been described and is illustrated with respect to a preferred embodiment thereof, it is to be understood that it is not to be so limited, since

changes and modifications may be made therein which are within the full and intended scope of this invention as hereinafter claimed.

What is claimed is:

1. A prosthetic ankle joint comprising:

a housing having a bottom portion and a top portion;

a front bumper and a rear bumper positioned within the housing between the bottom portion and the top portion;

a single pin passing through the front and rear bumpers for rigidly connecting the front and rear bumpers with the housing to provide multiple axis of movement of the ankle joint; and

means for attaching the ankle joint between a foot component and a lower leg component.

2. The ankle joint of claim 1 wherein the bumpers are polyurethane and the front bumper has a shore hardness higher than the rear bumper.

3. The ankle joint of claim 1 wherein the ankle joint further comprises at least one flange on the bottom portion, on the top portion, on the front bumper, and on the rear bumper such that the flanges are overlapping and each containing an axially aligned hole for the passage of the pin.

4. The ankle joint of claim 3 wherein the hole in the flange on the upper portion of the housing is elongated.

5. The ankle joint of claim 1 wherein the means for attaching the ankle joint between the foot and the lower leg components comprises a threaded hole located in the bottom portion of the housing and a prosthetic link positioned on the top portion of the housing.

6. The ankle joint of claim 1 wherein the front and rear bumpers include a vertical chamber for receipt of a cylindrical limiter.

7. A prosthesis comprising:

a lower leg component;

a foot component; and

a ankle joint comprising:

a housing having a bottom portion and a top portion;

a front bumper and a rear bumper positioned within the housing between the top portion and the bottom portion;

a single pin passing through the front and rear bumpers for rigidly connecting the front and rear bumpers with the housing to provide multiple axis of movement of the lower leg component; and

means for attaching the ankle joint between the foot component and the lower leg component.

8. The ankle joint of claim 7 wherein the bumpers are polyurethane and the front bumper has a shore hardness higher than the rear bumper.

9. The ankle joint of claim 7 wherein the prosthesis further comprises at least one flange on the bottom portion, on the top portion, on the front bumper, and on the rear bumper such that the flanges are overlapping and each containing an axially aligned hole for the passage of the pin.

10. The ankle joint of claim 9 wherein the hole in the flange on the upper portion of the housing is elongated.

11. The ankle joint of claim 7 wherein the means for attaching the ankle joint between the foot and the lower leg components comprises a threaded hole located in the bottom portion of the housing and a prosthetic link positioned on the top portion of the housing.

12. The ankle joint of claim 7 wherein the front and rear bumpers include a vertical chamber for receipt of a cylindrical limiter.