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2,731,645

## ANKLE JOINT FOR ARTIFICIAL LIMBS

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7 Claims. (Cl. 3-6)

This invention relates generally to artificial limbs and relates more particularly to improvements in ankle joints therefor, this application being a continuation-in-part of my copending application for Artificial Limb, Serial No. 49,719, filed September 17, 1948, now Patent No. 2,629,105.

It is an object of the invention to provide in an artificial limb an ankle joint wherein the articulated parts faithfully simulate the movements and actions of the corresponding natural elements.

Another object of the invention is to provide an artificial limb wherein the ankle joint is provided with a ball and socket arrangement which carries substantially the full weight of the user.

Still another object of the invention is to provide a device of this character having a shock absorbing control cushion which limits the movements of the socket and permits the foot to accommodate itself to uneven surfaces.

A further object of the invention is to provide an artificial limb having an ankle joint wherein there is a limited torque and lateral action therein.

A still further object of the invention is to provide simple means for retaining the shock absorbing cushion in position so that it will not work out of the joint.

A still further object of the invention is to provide means for adjusting the artificial foot relative to the plane of swing of the ankle joint, which plane of swing corresponds to the plane of swing of the knee joint.

Another object of the device is to provide an artificial limb of this character that is simple in construction, smooth in action, and easy to assemble.

Other objects and advantages of the invention will be brought out in the following part of the specification.

Referring to the drawings, which are for illustrative purposes only,

Fig. 1 is a perspective view showing an artificial limb embodying the invention;

Fig. 2 is an enlarged partial section of the ankle joint;

Fig. 3 is a section taken on line 3-3 of Fig. 2; and

Fig. 4 is a perspective view of the shock absorbing and control cushion.

Referring to Fig. 1, there is shown an artificial limb having a thigh member 10 connected by a knee unit, indicated generally at 11, to the upper end of a shank member or shin 12, which in turn is connected to a foot 13 by an ankle unit, indicated generally at 14.

Referring to Figs. 2, 3 and 4, the ankle unit includes a shank plate 15 secured to the adjacent end of the shank 12 by means of a bolt 16 and nut 17 located in a recess 18 in the shank. The shank plate is further secured to the shank by means of screws 19 which prevent rotation of the shank plate relative to the adjacent end of the shank. The shank plate is provided with a recess 20 adjacent the center thereof, in which is disposed a clevis 21 formed integral with the adjacent end of the bolt 16. Between the side members of the clevis is disposed a ball 22 secured between said clevis members by a rivet 23.

The foot 13 is provided with a foot plate 24 secured

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to the foot by screws 25 and provided with a forward extension 24a. The foot plate also has an opening 26 therein, which tapers upwardly and outwardly at the front and back, and in which is received a bolt 27 having an eye 28 with a bearing 29 which engages the ball 22 to thereby form a universal ball and socket connection. The bolt 27 is secured by a nut 30 which is disposed in a recess 31 in the bottom of the foot 13.

The shank plate is provided adjacent the front end with a transversely extending recess 32 which is concave in cross section and defined at the front by a depending portion 33. The extension 24a of the foot plate 24 is also provided with a transverse recess 34 which corresponds to the recess 32. The recesses 32 and 34 receive a transversely extending cylindrical instep portion 36 of a shock absorber and control cushion indicated generally at 37. The cushion also includes a pair of aligned cylindrical torque and lateral action portions 38 which are spaced apart to provide an opening 39 in which the ball and socket joint is received. The cylinders 36 and 38 are formed of any suitable resilient material such as rubber, and are connected together by a web 40. The opposite sides of the cylinders 38 are also connected together by a web 41.

The shank plate 15 is provided with recesses 42 on opposite sides of the recess 20, and the foot 13 is provided with corresponding recesses 43. The recesses 42 and 43 are concave in cross section and receive the respective cylindrical portions 38 of the cushion 37. The outer end of each of the recesses 42 is provided with a flange 44 which engages the respective sides of the portion 38 and retain the cushion 37 in position.

The rear end portion of the shank plate 15 is provided with a recess 46 which has an opening in the bottom thereof in register with the recess 47 in the shank for reception of one end of a bumper 48. The opposite end of the bumper is received in a recess 49 in the heel of the foot 13, said bumper being of any suitable resilient material such as rubber or the like.

In use the portion 36 will yield under compressive action between the bottoms of the recesses 32 and 34, and the portions 38 permit limited torque action and lateral action which, together with the ball and socket, provide the various actions required and effect close simulation of the actions of the natural ankle. It has been found that this mechanism permits the foot to accommodate itself to uneven surfaces in a most natural manner.

In the present ankle joint, the universal ball and socket is adapted to be the primary weight-carrying part. The shank plate 15 is carried by the shoulders at the upper end of the clevis 21 and the foot plate 24 carries the weight transferred through the ball and socket connection.

It is desirable to have the ankle swing in the same plane as the plane of swing of the knee joint. However, the foot of the individual does not necessarily have the same alignment. With some individuals the toe may be turned inwardly, while in others, it might be turned outwardly. The present invention provides means whereby the ankle joint will swing in the same plane as the plane of swing of the knee joint while, at the same time, positioning the foot in accordance with the natural position of the individual's foot. This positioning of the foot is accomplished by attaching the foot plate 24 to the foot member 13 so that said foot member will have the normal position without interfering with the position of the ball and socket joint of the ankle with respect to its plane of swing.

I claim:

1. An ankle joint for artificial limbs including a leg section and a foot member, comprising: a universal joint for connecting said leg section and foot member to-