

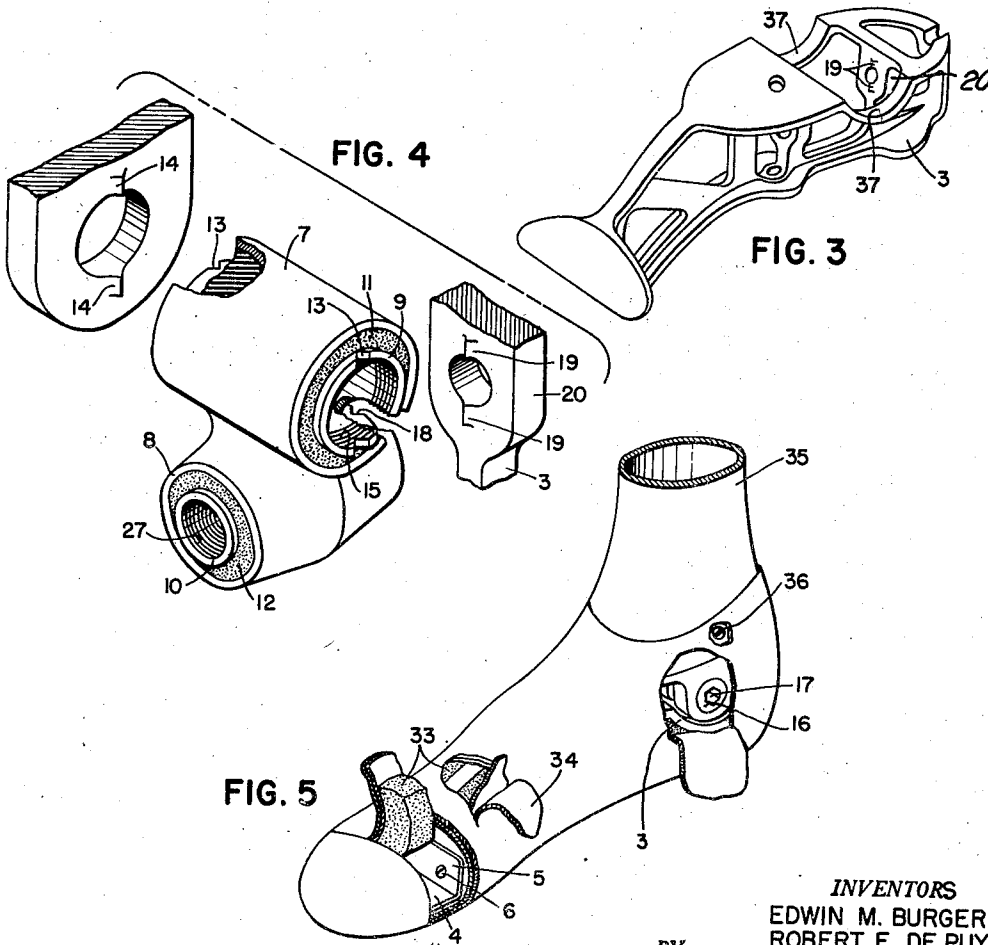
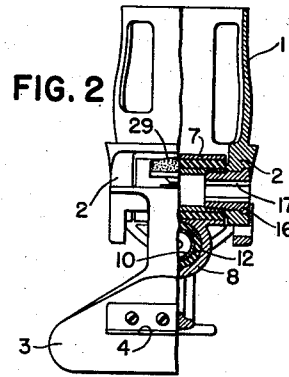
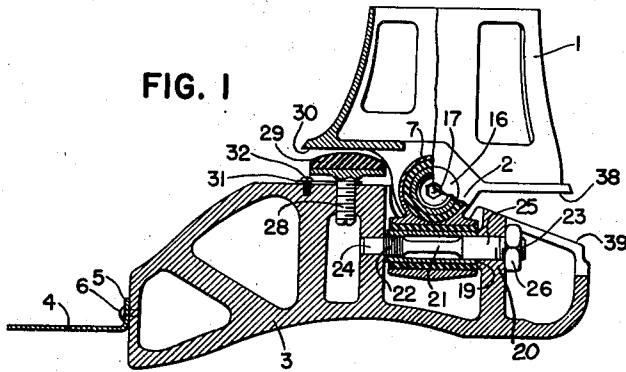
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PROSTHETIC DEVICE

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PROSTHETIC DEVICE

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1

The present invention relates to a prosthetic device and particularly to a prosthetic device which is to be used with a stump of a leg where the amputation is between the knee and the ankle, although its use is not limited solely to that type. For simplicity in describing the invention, reference will be made to the part that is attached to the stump as the leg portion; the part which is to go into the shoe as the foot portion, with a toe portion at the forward end of the foot portion. The part connecting the leg portion and the foot portion will be referred to as the ankle joint and it is with the ankle joint that this invention is primarily concerned.

One object of this invention is to provide a prosthetic device in which the ankle joint permits not only a forward and backward motion of the leg and foot portions relative to each other, but also permits a lateral movement at substantially right angles thereto. These movements, while permitted, are resisted by a torsional stress set up in the two rubber bushings of the ankle joint.

Another object of this invention is to provide an ankle joint in which the forward and backward movement of the leg portion relative to the foot portion, as well as the lateral motion thereof, is resisted by yieldable rubber means bonded or otherwise secured against slippage or movement relative to the bearing in which it is mounted.

Another object of the present invention is to provide a device in which the ankle joint is so constructed as to exclude from the operating parts thereof, any foreign matter that may tend to impair the functions thereof. Practically speaking, the device is so constructed that even without the covering on the foot portion and the leg portion, dirt and foreign matter are not likely to impair the operation of the device. At least foreign matter will not destroy the functioning, although it may temporarily tend to reduce its efficiency such as, for example, when sufficient foreign matter accumulates as to fill in any gaps between the articulated members. However, the construction is such that when this foreign matter is removed, the parts will still function as efficiently as before.

In many devices of this type, ball bearings and other bearings having relatively movable parts are damaged very readily by foreign particles accumulating therein. This destroys the efficiency of the device and it will not operate as well even after the foreign matter is removed.

Further objects of the invention will appear

2

hereinafter as the description thereof proceeds, the novel features, combinations and arrangement being clearly set forth in this specification and the claims thereunto appended.

In the drawings:

Fig. 1 is a side elevation of a prosthetic device embodying the invention; shown partly in section;

Fig. 2 is a front elevation view of the device looking from the left in Fig. 1;

Fig. 3 is a perspective view showing the construction of the main frame or foot portion;

Fig. 4 is an exploded view showing details of the ankle joint; and

Fig. 5 is a perspective view with parts broken away for the sake of clearness, illustrating the invention in its complete form, including the outer elastic covering therefor.

The leg portion 1 comprises a lightweight framework, preferably made of magnesium and cored out to effect the necessary lightness while retaining the desired strength. This leg portion has two downwardly extending ears 2 at opposite sides thereof, as viewed in Fig. 2, for a purpose which will be described presently. The foot portion 3 is a lightweight framework more clearly illustrated in Fig. 3 and also made of magnesium and cored out so as to effect a minimum amount of weight for this portion. In order to provide a toe portion of the requisite flexibility, the forward end of the foot portion may be and preferably is provided with a flat spring 4 having an offset portion 5 secured by rivets 6 or other suitable means to the foot portion 3. The toe portion 4 and the foot portion 3 are eventually covered with a layer of sponge rubber or plastic material which is preferably somewhat deformable and resilient and molded into the shape of a foot, the whole to be encased in a flexible stocking or the like.

The parts 1 and 3 are connected by an ankle joint shown in Figs. 1, 2 and 4. This joint, as best illustrated in Fig. 4, comprises two metal sleeves 7 and 8 integrally joined to each other at right angles. Each sleeve is provided with inner concentrically arranged sleeves 9 and 10, respectively, and arranged between the sleeves 7 and 9, and the sleeves 8 and 10 are bodies of rubber 11 and 12 which are held against slippage with respect to their respective sleeves. This may be done by highly compressing the rubber between the sleeves, cementing the rubber to the sleeves but, preferably, by vulcanizing the rubber into intimate adhesion with the contacting metal surfaces in a manner well understood in the art.

Primarily, the sleeve 9 is adapted to be con-

nected to the leg portion 1 in such a way as to be rigidly connected thereto and move therewith. Similarly, the sleeve 10 is adapted to be connected to and move with the foot portion 3. These sleeves are so connected to their respective parts that they cannot rotate with respect thereto, nor shift longitudinally thereof. In order to prevent the rotation of the sleeve 9 with respect to the leg portion 1, we provide notches 13 in the ends of the sleeve 9 into which the projections 14 on the ears 2 project. The sleeve 9 is internally threaded at both ends as at 15 and the hollow locking screws 16 are threaded into the sleeve 9 from either side to draw the ears 2 inwardly to cause the projections 14 to firmly seat themselves in the notches 13. As shown in Figs. 1 and 5 particularly, it will be noted that the screws 16 have hexagonal openings 17 in the ends thereof for the reception of a similarly shaped tool to be inserted therein for tightening up the screws 16.

The sleeve 10 is locked in a similar, although not identical, manner to that described with respect to sleeve 9. This sleeve is provided with notches only at one end thereof as at 18 and these are adapted to interlock with projections 19 on the portion 20 of the frame 3. A pin 21 threaded at 22 and 23 is inserted through the inner sleeve as best illustrated in Fig. 1 with the unthreaded portions 24 and 25 bearing in portions of the framework to carry the load. A nut 26 threaded on the portion 23 is used to draw the pin to the right which, in consequence of the engagement of the threaded portion 22 with the threads 27 on the inner portion of the sleeve 10, draws the pin to the right to cause the interlocking of the projections 19 with the notches 18. This rigidly locks the sleeve 10 with respect to the foot portion.

The sleeves 9 and 10 can be provided with a series of notches so that the sleeves may be mounted in selected angular positions if desired.

The forward motion of the leg portion relative to the foot portion is limited by a stop which comprises a threaded member 28 threaded into the foot portion and carrying a rubber pad 29 which engages the flat surface 30 on the leg portion 1. The threaded portion 28 of the stop permits vertical adjustment of the rubber pad 29 to vary the amount of permitted movement of the leg portion relative to the foot portion in a forward direction. A spring member 31 held in place by a screw 32 engages the threads 28 to permit locking the stop in its adjusted position. Any means can be used for this purpose.

Fig. 5 shows the completed prosthetic device with portions thereof laid open to better show the completed device in its final form. The sponge rubber or other light, yielding material 33 is built up around the frame of the foot portion 3 and the whole foot is encased in an elastic stocking such as 34. A plastic shin 35 overlies the leg portion 1 and is secured to the leg portion in any suitable manner as by a screw 36 passing through the plastic portion 35 and a suitable opening in the frame of the leg portion. This shin portion is usually provided at its upper end with a socket for the reception of the stump of the leg. However, in case of an amputation other than below the knee, it is possible to combine the shin portion with suitable knee joints and the like without affecting the operation of the foot portion.

By use of the rubber torsion bushings, the degree of flexibility of the angle joint can be varied by changing the characteristics of the rubber so

as to give varying degrees of resistance and rate to the articulation of the leg and foot portions. A different type of rubber can be used for one bushing than for the other in order, for example, to give greater stiffness or a different rate to one torsion unit. By having a selection of torsion units of varying degrees of stiffness or in various sizes, it is possible, without changing the other parts of the structure, to provide the prosthetic device with an ankle joint best suited to the individual requirements of the amputee. The action of the toe portion can be regulated by changing the stiffness of the spring 4.

The lateral rocking movement of the joint is limited by the engagement of the ears 2 with the arcuate portions 37 on the frame 3. Thus, if the rubber should fail for any reason or if the inner sleeve loses its locking engagement with the frame, the wearer will not be completely deprived of lateral support. Similarly, the rearward rocking of the leg portion relative to the foot portion is limited by the engagement of the opposed surfaces 38 and 39.

It will be understood, however, that various changes may be made in the particular arrangement, construction and combinations without departing from the spirit of the invention or the scope of the appended claims and, therefore, the invention is not limited except as may be hereinafter set forth in the claims hereunto appended.

Having thus fully described the invention, what is claimed and desired to secure by Letters Patent of the United States is:

1. A prosthetic device of the class described adapted to provide an artificial ankle joint capable of restrained and yieldable concurrent rotary movement between foot and leg members about transversely disposed axes shiftable in response to applied pressure, said device comprising the combination with foot and leg members of a pair of unitary superposed substantially cylindrical members disposed with their axes substantially at right angles to each other and in different horizontally disposed planes, a pair of similarly disposed separate sleeves each arranged within one of the cylindrical members in spaced relation thereto, a rubber torsion bushing secured in each cylindrical member about and in cooperative engagement with the sleeve disposed therein, means for holding the sleeve in the upper cylindrical member from rotary movement relative to the leg member, and means for holding the sleeve in the lower cylindrical member from rotary movement relative to the foot member.

2. A prosthetic device of the class described adapted to provide an artificial ankle joint capable of restrained and yieldable concurrent rotary movement between foot and leg members about transversely disposed axes shiftable in response to applied pressure, said device comprising the combination with foot and leg members of a pair of unitary superposed substantially cylindrical members disposed with their axes substantially at right angles to each other and in different horizontally disposed planes, a pair of similarly disposed separate sleeves, each of said sleeves being arranged respectively about one of said axes and within and in spaced relation to the cylindrical member which is coaxial with that one of said axes, a rubber torsion bushing secured in each cylindrical member about and in cooperative engagement with the sleeve disposed therein, means for holding the sleeve in one cylindrical member from rotary movement relative

5

to the leg member, and means for holding the sleeve in the other cylindrical member from rotary movement relative to the foot member.

3. A prosthetic device of the class described adapted to provide an artificial ankle joint capable of restrained and yieldable concurrent rotary movement between foot and leg members about transversely disposed axes shiftable in response to applied pressure, said device comprising a pair of unitary superposed substantially cylindrical members disposed with their axes substantially at right angles to each other and in different horizontally disposed planes, a pair of similarly disposed separate sleeves each arranged within one of the cylindrical members in spaced relation thereto, a rubber torsion bushing secured in each cylindrical member about and in cooperative engagement with the sleeve disposed therein, the sleeve disposed in the upper of said cylindrical members being interiorly threaded at each end thereof and having circumferentially spaced notches in the ends thereof, means for securing the latter sleeve to the leg member comprising a pair of downwardly extending ears spaced laterally to embrace the ends of said latter sleeve, circumferentially spaced projections on opposing faces of said ears registering with and lodged in said notches for holding said latter sleeve from rotary movement relative to said ears, bolts extending through said ears in threaded engagement with the interior threads at the ends of said latter sleeve for securing this sleeve and said ears together in fixed relation, a foot member, means for securing the other sleeve to the foot member comprising transversely disposed walls carried by and spaced longitudinally of the foot member to define a recess receiving and embracing the ends of said other sleeve and the lower cylindrical member, said walls having bores aligned substantially coaxially with the lower cylindrical member and said other sleeve to provide radial bearings for a tightening pin, the forwardly disposed end

6

of said other sleeve being interiorly threaded, a tightening pin fitting said bores and extending through said other sleeve and having threaded engagement with said interiorly threaded forwardly disposed end thereof, the rearwardly disposed end of said other sleeve having circumferentially spaced notches, circumferentially spaced projections on the forwardly facing side of the rearmost of said walls, said projections registering with and being lodged in said notches for holding said other sleeve from rotary movement relative to the foot member, said tightening pin having a threaded portion extending rearwardly of said rearmost wall, and a knot on the last mentioned threaded portion for drawing said tightening pin and said other sleeve against said rearmost wall.

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