

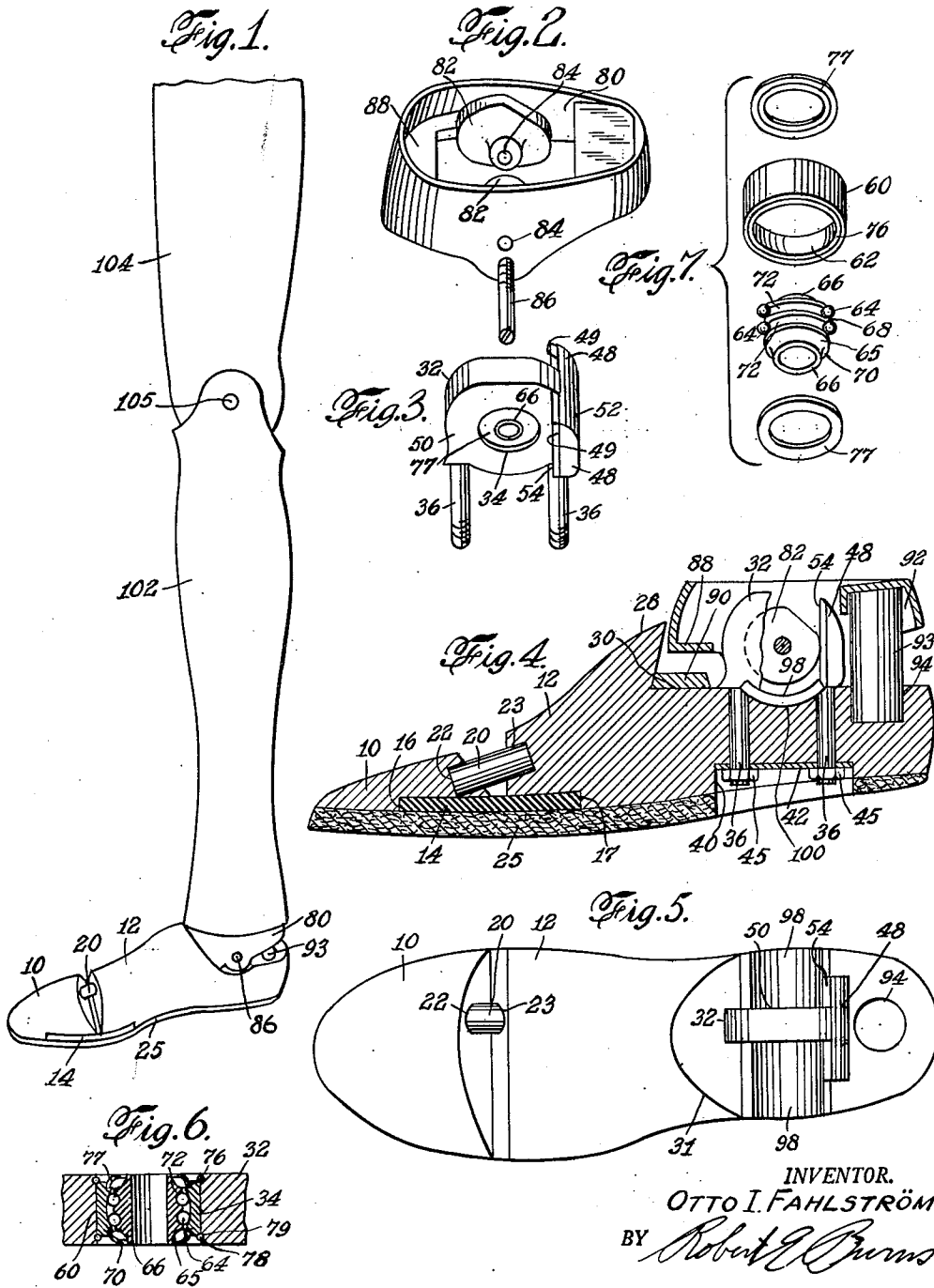
April 29, 1952

O. I. FAHLSTRÖM

2,594,752

JOINT CONSTRUCTION FOR ARTIFICIAL LIMBS

Filed Dec. 6, 1950



INVENTOR.
OTTO I. FAHLSTRÖM
BY *Robert G. Burns*

ATTORNEY.

UNITED STATES PATENT OFFICE

2,594,752

JOINT CONSTRUCTION FOR ARTIFICIAL LIMBS

Otto Ivan Fahlström, Stockholm, Sweden

Application December 6, 1950, Serial No. 199,379

3 Claims. (Cl. 287—96)

1

This invention relates to artificial body members and is more particularly concerned with an improved artificial foot and ankle member adapted for use with an artificial leg member.

In recent years many advances have been made in the construction of artificial limbs to be worn by leg amputees having amputations above and below the knee. The stiff artificial members formerly employed have given way to various devices which more closely simulate action of the natural leg. While many advances have been made in this direction, the known devices, however, still leave much to be desired. While the connection between an artificial leg and an artificial foot must have flexibility, it must also provide resistance to bending similar to that afforded by the muscles in the natural leg and foot. The ankle and foot portions of heretofore-proposed artificial leg members have not successfully met this problem of resistive flexibility, and attempts to provide the ankle joint portion of the artificial leg with the desired flexibility have generally been carried out by sacrificing the necessary resistance to flexing. As a result, the action of the natural ankle and foot has not been adequately simulated and the prior constructions have, for the most part, been difficult to manipulate gracefully even by experienced users.

It is the principal object of the present invention to provide an artificial ankle construction free from the disadvantages and deficiencies of prior constructions and forming an effective connection between an artificial foot and an artificial leg portion.

It is another object of the invention to provide an artificial ankle construction closely simulating in operation the natural human ankle.

It is another object of the invention to provide an artificial foot and ankle member of improved construction.

It is a further object of the invention to provide an ankle joint for artificial body members characterized by resistive flexibility.

According to the invention, I provide an artificial body member comprising a transverse socket means adapted to be secured to and mounted upon the rear portion of an artificial foot member and adapted to carry a pivotal saddle member to which the lower leg member may be secured. In the artificial ankle joint thus provided, the saddle member is permitted limited pivotal movement in substantially all directions but rotational movement of the saddle member is effectively prevented. Thus, when the foot and ankle member of the invention is secured to the

2

lower end of a lower leg member, the foot portion may be tilted a limited amount in any direction but will not effect any rotational movement with respect to the lower leg portion, thereby very closely simulating the action of the normal human foot with respect to the normal human lower leg. The socket member of the invention comprises an upright element adapted to be secured to the foot portion and having a transverse bore and wing portions extending laterally from its back portion. The bore of the upright element is provided with anti-friction bearings and carries a hollow shaft having an enlarged grooved external central portion adapted to form race-ways for the anti-friction bearings and being bored to receive the saddle supporting pin. The saddle portion has arcuate trunnion surfaces arranged to engage the forward surfaces of the wing portions when assembled with the socket member to prevent rotational movement of the saddle.

Other objects and features of my invention will be readily apparent from the following detailed description thereof and from the accompanying drawings, wherein,

Fig. 1 is a perspective view of an artificial limb having ankle and foot structures embodying features of the invention;

Fig. 2 is a perspective view of the saddle portion of the ankle joint;

Fig. 3 is a perspective view of the socket member;

Fig. 4 is a longitudinal sectional view showing the saddle and socket member assembled with the foot;

Fig. 5 is a top plan view of the foot portion and the socket member;

Fig. 6 is an enlarged sectional view showing details of the construction of the socket member; and

Fig. 7 is an exploded view of the bearing assembly carried by the socket member.

Referring to the drawing, the foot member illustrated comprises a toe portion 10, and a main portion 12 flexibly connected thereto for limited relative bending movement. A flexible sheet, for example a fabric sheet 14 impregnated with any convenient rubbery material such as rubber or rubbery synthetic compositions, is received in complementary recesses 16 and 17 in toe portion 10 and main foot portion 12, respectively, and is adhesively secured therein. A resilient rod member 20, suitably formed from rubber, is similarly received in cylindrical recesses 22 and 23. A layer of felt or like material 25 is

3

adhesively secured to the lower surface of foot portions 10 and 12 and sheet 14. This construction permits the main portion 12 to be flexed relative to the toe portion 10 during walking but is adapted to offer resistance to excessive flexing and to return the two portions to their original alignment when the flexing pressure is released.

As may be clearly seen in Fig. 4, the main foot portion 12 is provided with an in-step portion 28 which is intercepted by a flat horizontal portion or platform 30. The platform 30 joins the in-step portion 28 along an arc 31, and the top of the in-step portion 28 is connected to the platform 30 by a forwardly tapered arcuate surface. As will be apparent, as the description proceeds, this formation is adapted to accommodate the forward end of the saddle portion of the body member of the invention. Mounted centrally of the platform 30 is the upright socket member 32. Socket member 32 is formed with a transverse bore 34 and is provided with two downwardly extending bolt shafts 36 which are threaded at their ends and pass through suitably-spaced vertical apertures in foot portion 12. The lower surface of the foot portion 12 is formed with a recess 40 into which the bolt shafts 36 extend. A plate 42 is seated in the recess 40 and is provided with two apertures for receiving the ends of the shafts 36. The socket member 32 is secured to foot portion 12 by means of nuts 45 which threadedly engage the shafts 36 and press plate 42 against the top of recess 40. The felt layer 25 is, of course, suitably cut away as it passes adjacent recess 40.

The rear portion of socket member 32 has laterally extending wing portions 48 which, in the embodiment shown, are integral with socket member 32 and have plane forwardly directed surfaces 49 extending substantially at right angles to the side walls 50 of the main portion of socket member 32 and have a curved rear surface 52. The surfaces 49 are suitably covered by strips 54 of so-called hard-board or like non-metallic hard material, conveniently secured, as by riveting or by means of an adhesive, to the wing portions 48.

Positioned in the bore 34 of socket member 32 is the pivot joint arrangement which is characteristic of my improved construction. As may be clearly seen by reference to Fig. 5 this pivot joint arrangement comprises a cylindrical element 60 having an outer surface fitting snugly in the bore 34 and having a curved inner bore 62. As shown in Fig. 6, the anti-friction bearings are in the form of two parallel circular rows of ball bearings 64. Positioned centrally of the cylindrical element 60 and extending axially through the two circular rows of anti-friction bearings 64, which in the embodiment shown are ball bearings, is a tubular element 65 having cylindrical end portions 66 and an enlarged external cylindrical central portion 68, joined to the end portions 66 by a tapered surface 70. Central portion 68 is provided with two spaced annular grooves 72 in which are seated the ball bearings 64. The dimensions of the parts are such that the ball bearings 64 fill the annular space between the bottom of the grooves 72 and the inner curved wall of the bore 62 of cylindrical element 60. It will be observed that the cylindrical element 60 is formed with curved bore 62 which the ball bearings 64 engage and has annular recesses 76 at its ends in which are press-fitted the end rings 77. These end rings have an aperture conforming in diameter substantially to but

4

slightly less than the diameter of the enlarged central portion 68 of tubular member 65, whereby tubular member 65 is free to pivot until engagement of the cylindrical end portions 66 with the internal rim of rings 62. The cylindrical element 60 is slightly shorter than the length of the bore 34 of socket member 32 and is held in position by means of locking rings 78 which are received in suitable annular recesses 79 in the walls of bore 34.

Cooperating with the socket member 32 to provide the improved artificial ankle joint of my invention is the saddle 80 which is adapted to receive the lower leg member of the artificial leg. Saddle 80 is substantially elliptical in outline and has trunnion portions 82 provided with bores 84 substantially equal in diameter to the bore of the tubular member 65. One of the bores 84 is tapped and is adapted to threadedly engage a bolt 86 for connecting saddle 80 with socket member 32 when the joint is assembled. The trunnion portions 82 are spaced apart sufficiently to form a relatively close fit with the ends of the tubular member 65 so that lateral play is minimized. The forward portion of saddle 80 is provided with a lower surface 88 which corresponds in shape substantially with the forward portion of the platform 30. A resilient pad 90 is secured, as by an adhesive, to the forward portion of platform 30 and is adapted to be engaged by the surface 88 upon forward pivoting of the saddle 80 in the socket member 32. The upper rear portion of the saddle is formed with a recess 92 which is adapted to receive a resilient cylinder 93, formed from rubber or the like and seated in an aperture 94 in the rear portion of foot portion 12, as clearly shown in Fig. 4. On the foot portion 12 under the trunnion members 82 are positioned two pads 98 formed from leather or the like and adhesively secured in two arcuate recesses 100 formed in foot portion 12. When the assembled saddle is in normal horizontal position, the trunnion members 82 do not engage the pads 98 but do so upon limited lateral pivotal movement. The pads thus permit limited pivotal movement but serve resiliently to resist undue pivotal movement of the saddle 80. Similarly, pad 90 and resilient cylinder 93 serve to permit limited forward and rearward pivotal movement of saddle 80 but resist any excessive movement in these directions. The saddle thus has resistive flexibility in all pivotal directions. It is a feature of my construction, however, that the trunnions 82 engage the forward surfaces of the wing portions 48 and effectively prevent any rotational movement of the saddle relative to the socket member 32. The portions of the trunnions 82 which engage the wing portions 48 are suitably curved so that they are at all times in engagement with the forward surface of the wing portions. Since the socket member 32 and the saddle 80 are advantageously formed of aluminum in order to avoid unnecessary weight, the portions of the trunnions 82 which engage the pads 98 and the strips 54 are conveniently covered with any suitable wear-resistant low friction metal or the like.

The outer surface of the saddle 80 is formed to receive the lower leg portion of the artificial leg assembly. For the leg portions of the assembly I advantageously employ, as shown in Fig. 1, hollow aluminum members of the type described in my copending application, Serial No. 84,542, filed March 31, 1949, although other leg members may be used. The lower leg member 102 is shaped to

5

fit over the saddle 80 with a friction fit and may be secured by bolting, riveting or other convenient means. As shown in Fig. 1, for above the knee amputations the leg is also provided with a thigh portion 104 which is articulately connected with lower leg portion 102 at 105. The thigh portion 104 is advantageously constructed in accordance with my said copending application, Serial No. 84,542 although it will be understood that other leg constructions may be employed.

While I have shown and described a preferred embodiment of my invention, it will be apparent to those skilled in the art that various changes and modifications in the embodiment shown may be made without departing from the scope of the invention as defined in the appended claims and it is intended, therefore, that all matter contained in the foregoing description and in the drawings shall be interpreted as illustrative and not in a limiting sense.

What I claim and desire to secure by Letters Patent is:

1. A joint construction for artificial limbs, comprising a socket member adapted to be secured to an artificial foot, means forming a transverse bore in said socket member, a tubular member extending axially through said bore and pivotally mounted therein, wing portions extending laterally from the rear of said socket member, a saddle connected to said tubular member and adapted to pivot about said socket member, said saddle having trunnion portions engaging said wing portions during pivotal movement of said saddle whereby to prevent rotational movement of said saddle, said saddle member being adapted to be connected with the lower portion of the artificial limb.

2. A joint construction for artificial limbs, comprising a socket member adapted to be secured to an artificial foot, means forming a transverse bore in said socket member, a tubular member

6

extending axially through said bore and pivotally mounted therein, anti-friction bearings being disposed between the surface of said tubular member and the walls of said bore, wing portions extending laterally from the rear of said socket member, a saddle connected to said tubular member and adapted to pivot about said socket, said saddle member having trunnion portions disposed opposite the ends of said tubular member and engaging said wing portions during pivotal movement of said saddle whereby to prevent rotational movement of said saddle, said saddle member being adapted to be connected with the lower leg portion of the artificial limb.

3. A joint construction for artificial limbs comprising a socket member adapted to be secured to an artificial foot, a transverse tubular member pivotally mounted in said socket member, wing portions extending laterally from the rear of said socket member, a saddle connected to the ends of said tubular member and adapted to pivot about said socket member, said saddle having trunnion portions disposed opposite the ends of said tubular member and engaging said wing portions during pivotal movement of said saddle whereby to prevent rotational movement of said saddle, said saddle member being adapted to be connected with the lower leg portion of the artificial limb.

OTTO IVAN FAHLSTRÖM.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,767,868	Barghausen	June 24, 1930
2,098,067	Simonsson	Nov. 2, 1937
2,207,473	Beck	July 9, 1940
2,298,463	Burt	Oct. 13, 1942