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UNITED STATES PATENT OFFICE.

GEORGE E. MARKS, OF NEW YORK, N. Y.

ARTIFICIAL LIMB.

SPECIFICATION forming part of Letters Patent No. 489,258, dated January 3, 1893.

Application filed August 6, 1892. Serial No. 442,317. (No model.)

To all whom it may concern:

Be it known that I, GEORGE E. MARKS, a citizen of the United States, and a resident of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Artificial Limbs, of which the following is a specification.

The invention relates to improvements in artificial limbs, and particularly to artificial limbs for amputations below the knee or elbow.

The invention consists in a novel jointed connection between the members of the artificial limb adapting the same to harmonious action with the movements of the natural knee.

The object of the invention is to produce a joint connection between the members of the artificial limb which will yield to and harmonize with the particular motions of the natural limb due to the varied form of the femoro-tibial articulations; thus the artificial limb will be made to accommodate itself to the special conditions of the natural limb, in lieu of forcing the latter to yield to the usual fixed joint at present in use on artificial limbs, and hence greatly increased comfort and ease are secured to the wearer and the artificial limb is improved in appearance and in other characteristics enhancing its value to those requiring its use.

The surfaces of the femoro-tibial articulations are, except in possibly rare instances, polycentric; and hence in carrying out my invention I have produced a joint which will admit in the artificial limb the varied polycentric lines of motion present in the natural knee, thus harmonizing the action and allowing in the natural leg its proper movements with the maximum extent of genuflexion.

My invention further consists in certain details of construction pertaining to the joints in artificial limbs, as hereinafter fully explained.

Referring to the accompanying drawings:—Figure 1 is a side elevation of an artificial leg constructed in accordance with and embodying the invention; Fig. 2 is an enlarged detached view, partly in section and partly broken away, of the connections uniting the members of the artificial leg and embodying the present invention; Fig. 3 is an enlarged

detached side elevation of one of the joints employed in the said connections; Fig. 4 is a central vertical section of same on the dotted line 4—4 of Fig. 3; Figs. 5 and 6 are detached end and side views of certain removable bearing-bushings employed in the joints of said connections; Fig. 7 is a side elevation of an artificial leg whose members are united by connections forming a modified construction of the invention; Fig. 8 is a detached side elevation of a modified form of joint which may be used in the leg connections; Fig. 9 is a central vertical section of same on the dotted line 9—9 of Fig. 8; and Fig. 10 is a side elevation of an artificial leg whose members are united by uni-centric connections in the usual manner and illustrating the unnatural conditions which exist when the same is applied to a natural leg whose femoro-tibial articulations are poly-centric.

In the accompanying drawings, Figs. 1 to 6 inclusive, is illustrated the preferred embodiment of the invention for universal use, and in said figures A, B, respectively designate the lower and upper members or stump and thigh sockets of the artificial limb adapted to receive the remaining portion of the natural leg C and united by the hinged or jointed connections composed of the straps D, E, and link F.

The particular form and construction of the members A, B, constitute no part of the present invention, which is confined to the novel connections uniting said separated members.

The straps D, E, are riveted or otherwise secured to the opposite sides of the sockets or members A, B, as indicated in Fig. 1, and at their adjoining ends are connected by links F which are pivotally secured at each end.

The invention is not limited in every instance to the particular instrumentality connecting the ends of the link F to the straps D, E, but in the drawings are illustrated novel joints or centers *a, b*, therefor, which are shown more clearly in Figs. 3 and 4.

In accordance with that portion of my invention pertaining to the joints or centers *a, b*, the adjoining ends of the straps D, E, are provided with the longitudinal ears *d, e*, having transverse apertures adapted to the screws

f and being sufficiently separated to snugly receive the ends of the link *F*, which ends are provided with apertures *i* concentric with the apertures in the ears *d, e*. The apertures *i* are lined with the bushings *m*, see Fig. 6, which tightly fit said apertures but are removable therefrom when desired; and said bushings are prevented from rotating in said apertures by means of the ribs *n* thereon engaging corresponding grooves in the edges of said apertures, as indicated by full lines in Fig. 2 and dotted lines in Fig. 3. The hub of the screws *f* extends through the ear *e* and aperture *i*, as shown in Fig. 4, and is incased by the tightly fitting removable bushing *t*, (shown detached in Fig. 5) which is prevented from having any revolving motion by the rib *w* engaging a corresponding groove in said hub, as indicated by full lines in Fig. 2 and dotted lines in Fig. 3.

In arranging the parts composing the joints *a, b*, the bushing *m* will be inserted in the apertures *i* and the bushings *t* on the hubs of the screws *f*, after which the ends of the link *F* will be introduced between the ears *d, e*, of the straps *D, E*, and the screws *f* applied, thus securing the parts together in a pivotal manner and bringing the surfaces of the bushings *m, t*, against each other to form the bearings for the joints, as shown in Fig. 4. The object of thus providing the joints or turning centers *a, b*, with the bushings *m, t*, is to prevent all wear on the link *F* and strap *D, E*, and thus to confine the wear to the said bushings, which upon becoming worn may be readily removed and new bushings quickly substituted by the wearer at trifling expense.

The screws *f* may be locked in position by means of small screws *x*, which will prevent the screws *f* from working loose during the use of the leg.

In Figs. 8 and 9 is shown a modified form of joint connecting the link *F* and strap *D*, but employing the bushings *m, t*, as in the construction shown in Figs. 3 and 4.

In Figs. 8 and 9 is shown a combined screw *y* and non-revoluble bolt *z* of well known form, the novel bushings *m, t*, being employed in connection therewith in the manner and for the purpose indicated in Figs. 2, 3 and 4.

In the use of the artificial leg having its members united by the connections illustrated in Figs. 1 to 6 inclusive it will be apparent that the plurality of joints or bearing centers will permit the natural movements of the leg without restraint and without regard to the special local characteristics of the femoro-tibial articulations. The thigh socket, owing to the link *F* and plurality of centers *a, b*, may move forward or backward or upward or downward in accordance with the natural condition and movement of the leg, and hence free and full genuflexion is permitted and displacement and irritation prevented. As above described, the link *F* and centers *a, b*, permit the artificial leg to yield to the varying polycentric lines of motion in

the natural knee, and hence there is no restraint on the natural leg and the sockets may be firmly secured without causing any discomfort. The artificial leg may thus be worn with great ease and benefit.

In Fig. 10 I illustrate the conditions which sometimes exist when the members of the artificial leg are united by uni-centric connections, which do not permit the free movement or genuflexion secured in the connections having a plurality of centers, and in this figure it will be observed that the natural leg must yield to the artificial leg and hence that the knee cannot move forward while bending but is held back by the thigh socket and joint, the result being that the tissues crease in the popliteal region, producing pain, and irritation, and limiting genuflexion, and that the stump is withheld from the upper anterior portion of its socket, as indicated, thus producing the effect of throwing the hubs of the joints forward or leaving them in a position in which when the wearer is seated they form annoying projections, which are not only disagreeably perceptible but distort and destroy the clothing. Various disadvantages result from the use of the uni-centric joint on legs whose femoro-tibial articulations are polycentric, and they pertain both to the health and comfort of the wearer and the appearance of the leg. The present invention obviates all the disadvantages due to the uni-centric joint by providing a plurality of centers and causing the artificial leg to yield to the polycentric movements in the natural limb, the centers being separately and together under the control of the knee and adapted to harmonize with its movements, insuring great ease, comfort and full genuflexion, and avoiding the hub projections in the clothing at opposite sides of the knee.

The invention is not confined to the particular length or form of the link *F*, since for some conditions it may be desirable to lengthen it and secure its outer end farther up the side of the thigh socket, as shown in Fig. 7, in which it will be observed that the outer end of the link is pivotally secured to the outer end instead of to the inner end of the strap *E*. If, in Fig. 7, the strap were omitted, the end of the link would be pivotally secured directly to the socket, thus the latter would serve as a combined strap and socket. Whatever may be the special form and construction of the connections there will be a plurality of joints to permit the artificial leg to yield to the polycentric movements of the natural leg and the members of the artificial limb will be separated a sufficient distance from each other to permit their yielding to the polycentric curves of motion in the natural limb. The ends of the link *F* are provided with the abutting shoulders *G*, which prevent any undue forward movement on the centers or joints *a, b*.

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

1. The artificial limb having the lower and upper members A, B, said members being separated by an open space to receive the natural joint, combined with the links F pivotally secured at each end and connecting said separated members, and the abutting shoulders to prevent the links from turning unduly forward; substantially as and for the purposes set forth.
2. The artificial limb having articulated members, combined with the hinged joint connecting said members, said joint being composed of one arm having the apertured ears *d*, *e*, a second arm having its apertured end between said ears, the removable bush- ing *m*, having the exterior rib *n* and fitting the conforming aperture in said second arm, and the removable bushing *t* having the interior rib *w* and fitting the conforming surfaces of the screw or bolt of the said hinged joint, substantially as and for the purposes set forth.

Signed at New York, in the county of New York and State of New York, this 4th day of August, A. D. 1892.

GEORGE E. MARKS.

Witnesses:

CHAS. C. GILL,
ED. D. MILLER.