J. E. HANGER.

ARTIFICIAL LIMB.

APPLICATION FILED JULY 24, 1911.

1,066,605.

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Fig. 1.

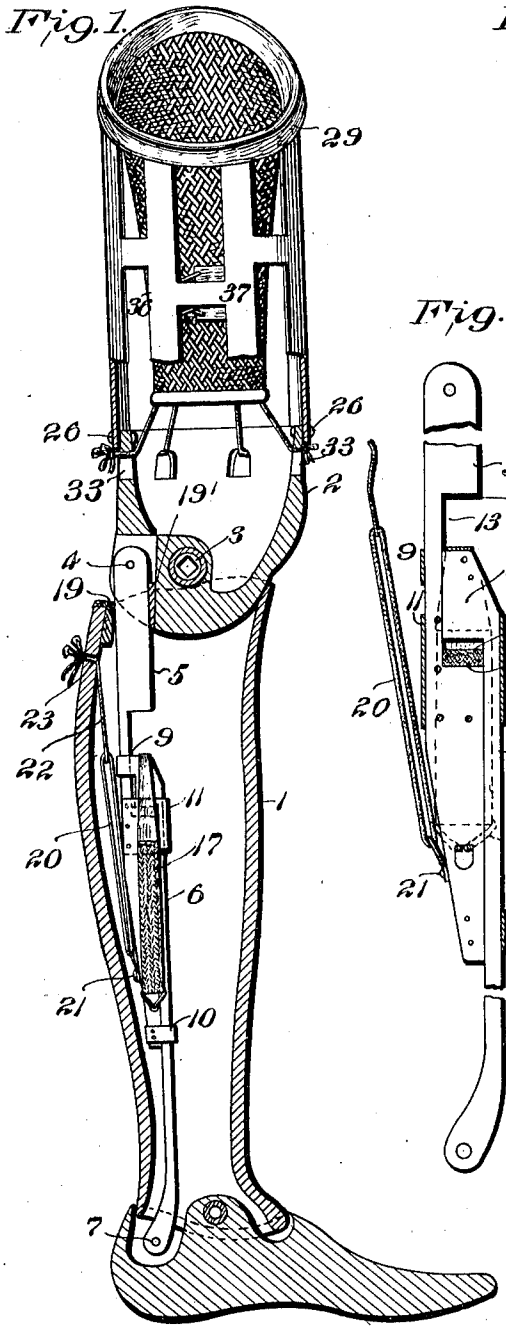


Fig. 2.

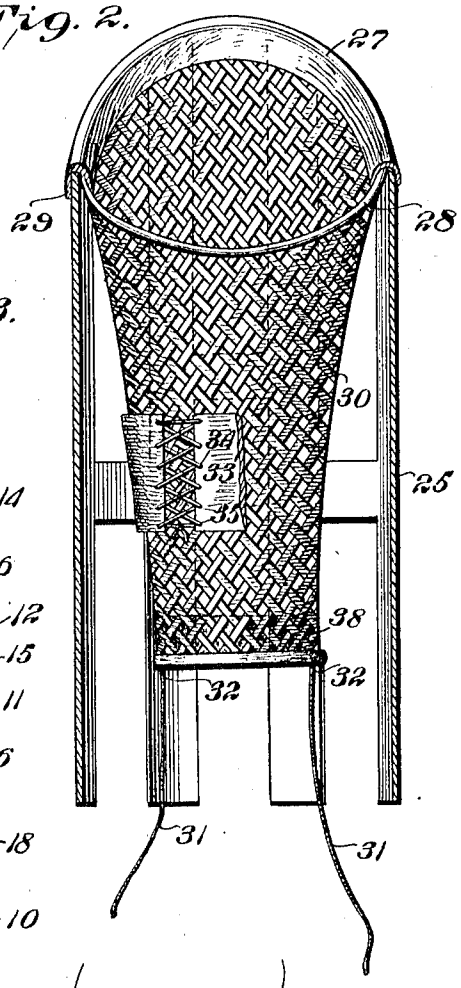
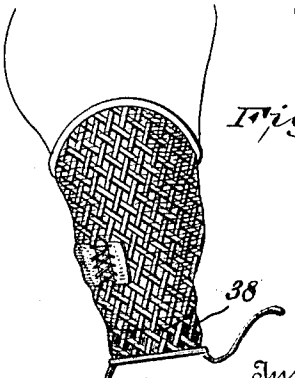


Fig. 3.

Fig. 4.



Witnesses

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ARTIFICIAL LIMB.

1,066,605. Specification of Letters Patent. Patented July 8, 1913.

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To all whom it may concern:

Be it known that I, JAMES E. HANGER, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Artificial Limbs, of which the following is a specification.

This invention relates to artificial limbs; and it comprises an artificial limb made up of knee and foot members and two independently connected supporting members, jointed to said knee and foot members, both of which supporting members are laterally rigid, but one of which is longitudinally yieldable.

It also comprises a novel connecting member, laterally rigid, but longitudinally yieldable, and provided with means for returning the parts of said member to this normal position when such parts have been longitudinally displaced.

It further comprises a novel socket for securing the artificial limb to the body of the wearer, said socket being both longitudinally and circumferentially extensible and contractible, and being made up of flexible or fibrous material woven diagonally, or provided with diagonally arranged spaces separating the fibers or strips or connecting parts of which the socket is made up; and it further comprises certain novel means for adjusting and holding said socket in any desired position with respect to its frame; all as more fully hereinafter set forth and as claimed.

The artificial limb and socket made according to the present invention are simple in operation and construction, and give to the wearer a feeling of comfort and security, and an ease and smoothness of operation approaching that of the natural leg and foot.

In the accompanying drawings, wherein is shown one specific embodiment of the present invention: Figure 1, is a vertical section of an artificial limb embodying the invention, the socket and framework being shown in part in elevation. Fig. 2, is a perspective view of one form of the novel socket, with the frame partly broken away. Fig. 3, is an enlarged detail of one form of the novel longitudinally yieldable connecting member, and Fig. 4, shows the socket applied to the body of the wearer.

The artificial limb is shown in the drawings as made up of knee and foot members, 2 and 2^a, with the two independently connected supporting members jointed to the knee member at 3 and 4 and to the foot member at 8 and 7. In the specific embodiment of the invention shown the longitudinally and laterally rigid supporting member is shown as the leg member 1, connected to the knee by the knee joint 3 and to the foot by the ankle joint 8. The laterally rigid but longitudinally yieldable supporting member is shown as made up of two sections 5 and 6, the upper member 5 being shown as pivoted to the knee section at 4, behind the knee joint, and the lower section 6, as pivoted to the foot member at 7, behind the ankle joint. For convenience, as well as for compactness and appearance, the longitudinally yieldable member is shown as located within the hollow leg member.

The two members 5 and 6 are longitudinally movable with respect to each other, but are so connected that they form a laterally rigid supporting member. In the form of the invention shown these two members are connected to the knee and foot members behind the knee and ankle joints and they are shown as held normally in extended relation by a spring, and as capable of yielding longitudinally, shortening in combined length when longitudinal compression is applied to them as in walking.

The specific form of yieldable connecting member is shown more in detail in Fig. 3. In this figure the members 5 and 6 are clamped slidably together through the telescopic clamps or guides 9 and 10. The clamp 11, attached to the member 5 also serves as a guide. The member 5 is cut away at 13 and is provided with abutments 14 and 15. The enlarged section 16 of the lower member 6 is adapted to slide in this cut away portion of the section 5. A bumper 12, advantageously composed of rubber or soft felt is provided on section 5 to absorb the shock, and give a slight yielding action when the parts 16 and 15 come together. This bumper 12 is held in place laterally by the guide 11. The members 5 and 6 in the form of the invention shown, are normally held with the parts 15 and 16 together. For securing such members in normal position yieldable devices, shown as elastic straps 17, are provided, attached to lever 5 by ties 18 passing through holes in said section, and thence upward over the top portion 16 of section 6. This yieldable

element enables the two members 5 and 6 to move relative to each other when compression or a weight is applied at their ends, the yieldable element or spring returning such members to their normal extended position when the weight or compression is removed.

A bumper 19 is provided at the upper end of the leg member 1, against which the member 5 is adapted to abut, and a stop 19, preferably of felt, is provided for the other side of the member 5. These stops or bumpers serve as springs or as shock absorbers. The strap 20 is arranged diagonally between the leg member and the yieldable supporting member, being connected to the leg member by ties 22 passing through holes 23 and to the member 5 of the longitudinally yieldable member at 21. This member is elastic and yieldable, so that when the leg is bent this member is stretched and when the weight is released from the foot in the walking operation it aids in returning the leg to its straightened position. The yieldable member 20 thus forms an elastic connection diagonally connecting the two parallel supporting members, one of which in the specific embodiment shown, is the leg 1, and the other the yielding member 5—6 .

During the walking operation, (the reference being particularly to the specific embodiment of the invention shown), as the heel strikes the ground the weight of the body is transmitted directly from the center of support situated in the socket to the heel. The line joining the center of support and the heel passes back of the knee joint 3, but in front of the joint 4 of the yieldable supporting member. As a result the weight of the person is transmitted through the two connecting members, but mostly through the yieldable member 5—6 which acts as a cushion or spring much the same as in the action of the human leg and foot. When the heel first strikes the ground the weight is thrown principally on the joint 7 and through it on to the yieldable member which is now under compression and as a result becomes somewhat shortened in length. Moreover, at this time, when the heel first strikes the ground and when there is the greatest danger of the knee joint flying forward or flexing, the action of the yieldable supporting member, joined as it is in parallel relation with the leg member, and connected to the knee member back of the knee joint, and also back of the line of support referred to, is to lock the knee joint against flexing or springing forward.

After the heel strikes the ground, as the body moves forward, the weight is transferred from the heel to the heel and ball, and finally to the ball and toe of the foot member. As the weight thus changes from the heel to the ball the yieldable member elongates, owing to the spring 17, and the weight passes to the leg member, the line of application of the weight of the body tending to pass forward as the weight of the body passes forward, so that as the weight reaches the toe this line of application may be in front of the knee joint in which case the yieldable member would be in tension, the parts 15 and 16 being together and compressing the spring 12, which gives a slight yielding action.

As the knee joint is bent and the leg swung backward in walking the parallel arrangement of the two supporting members serves to keep the foot nearly in its normal position with the toe somewhat elevated during the forward stride, and at the same time the yieldable nature of the member 5—6 prevents shocks and unnatural motions. Moreover, the yieldable supporting member enables the foot to adjust itself to any slight irregularities in the surface walked upon and thus minimizes the dangers of such irregularities and obstructions.

One embodiment of the socket made according to the present invention is shown in detail in Fig. 2, and as applied to the stump in Fig. 4. This socket is provided with a framework 25 shown as connected to the limb by the rivets 26. This frame is made to conform to the limb of the person, and is shown as conforming in its upper contour to the shape of the hip and provided with a high side 27 and a lower side 28. This frame is shown as covered with leather or canvas at its top, as at 29, and to this covering the socket 30 is attached, as by riveting or stitching, so that the socket is securely fastened at its top and depends and swings in the frame, as shown. This socket is composed of braided or loosely woven material, paraffined canvas, leather, linen, etc., shaped approximately in the form of the stump. This socket as thus made is capable of longitudinal elongation and contraction and of simultaneous circumferential contraction or expansion. It is moreover capable of circumferential contraction or expansion simultaneously at different parts to enable it to conform to the shape of the stump. Such conformability is illustrated by Fig. 4. This socket is shown provided with ties 31 attached at 32 and passing through holes 33 and securely attached to the limb. These strings enable the socket to be held centered in the frame, or to one side as desired and in the form of the invention illustrated also enable the socket to be elongated and held elongated, which is particularly advantageous in cases where the stump cannot take end bearing in the socket. Padding 38 is provided in the bottom of the socket for the end of the stump to rest on, as to be supported by in

case the stump can take end bearing. The universal adjustability of the socket of the present invention, both longitudinally and circumferentially enables it to adjust itself easily and comfortably to any irregularities in the stump to which applied. When the weight of the wearer is removed from the stump and socket, the socket also yields uniformly and relieves the stump from irritation and other untoward effects, inherent in the old rigid sockets.

In cases where the socket swings too freely in its frame, or where it is desired to provide means for holding the socket in some particular position in the frame, additional centering or positioning means may be provided. In the embodiment of the invention illustrated the socket frame is shown as provided with an adjustable retaining element or strap 33, having eyes 34 and lacings 35 and secured to the frame at 36 and 37, about midway the length of the socket. By means of such adjusting and retaining elements the socket can be accurately centered or held in the desired position to the front or back or to one side of its frame, and the limb made to hang in the desired position.

With a socket such as that of the present invention which is capable of adjustment within its frame it is possible to vary the center of support located in the socket and to bring the same nearer the front or back of the socket as desired. The arrangement is such that in the specific embodiment of the invention shown the line joining this center of support in the socket and the heel passes back of the knee joint and in front of the joint 4. The adjustable nature of the socket enables this arrangement to be obtained and irregularities such as those of the stump provided for.

Various changes in the construction and arrangement of the parts of the structure of the present invention can be made without departing from its principal and intended scope, as set forth in the appended claims.

I claim:

1. An artificial limb comprising knee and foot members, a leg member capable of withstanding compression jointed to said knee and foot members, and a longitudinally yieldable supporting member jointed to said knee member behind the knee joint and to the foot member behind the ankle joint.

2. An artificial limb comprising knee and foot members, a leg member capable of withstanding compression jointed to said knee and foot members and means independent of said leg member for yieldably supporting said knee member from the heel of said foot member.

3. In an artificial limb a longitudinally yieldable but laterally rigid supporting member, comprising two slidably connected rigid elements normally held in extended relation by a spring.

4. An artificial limb comprising knee and foot members, two independently connected supporting members jointed to said knee and foot members, the joints of one of said supporting members being behind the joints of the other, and an elastic connecting member connecting said supporting members and diagonally arranged with respect to the same.

5. An artificial limb comprising knee and foot members, a leg member jointed to said knee and foot members and a longitudinally yieldable supporting member jointed to said knee member behind the knee joint and to the foot member behind the ankle joint, and inclosed by said leg member, and a yieldable member connecting said yieldable supporting member with the leg member, and diagonally arranged with respect to said leg and supporting members.

6. In an artificial limb a socket made of diagonally arranged yieldable material with diagonally arranged spaces in such material, and being both longitudinally and circumferentially extensible and contractible.

7. In an artificial limb a socket made up of diagonally woven or braided material, a frame for said socket, and means for holding said socket in extended position in its frame.

8. In an artificial limb a socket, a frame for said socket, and means for adjusting said socket intermediate its length, relative to said frame.

9. In an artificial limb a socket, a frame for said socket, means for adjusting the lower end of said socket relative to its frame, and means for adjusting said socket intermediate its length relative to said frame.

10. In an artificial limb a longitudinally yieldable supporting member made up of upper and lower rigid members provided with spring means yieldable under both tension and compression.

11. In an artificial limb a longitudinally yieldable supporting member made up of upper and lower rigid members telescopically connected together and provided with spring means yieldable under both tension and compression.

In testimony whereof, I affix my signature in the presence of witnesses.

JAMES E. HANGER.

Witnesses:

SAML. H. ARNALL,

J. FRANK WILLSON.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."