Sept. 8, 1925.

1,552,869

J. NEVIN

ARTIFICIAL LEG

Filed April 19, 1924

2 Sheets-Sheet 1

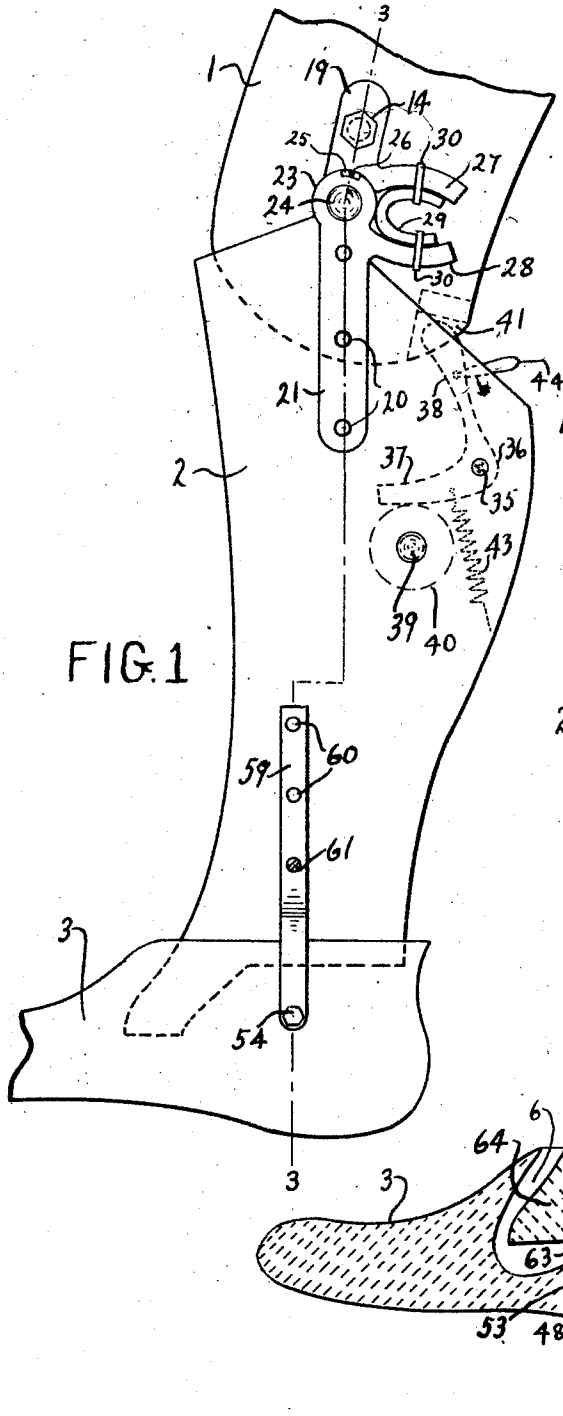

FIG. 1

FIG. 2

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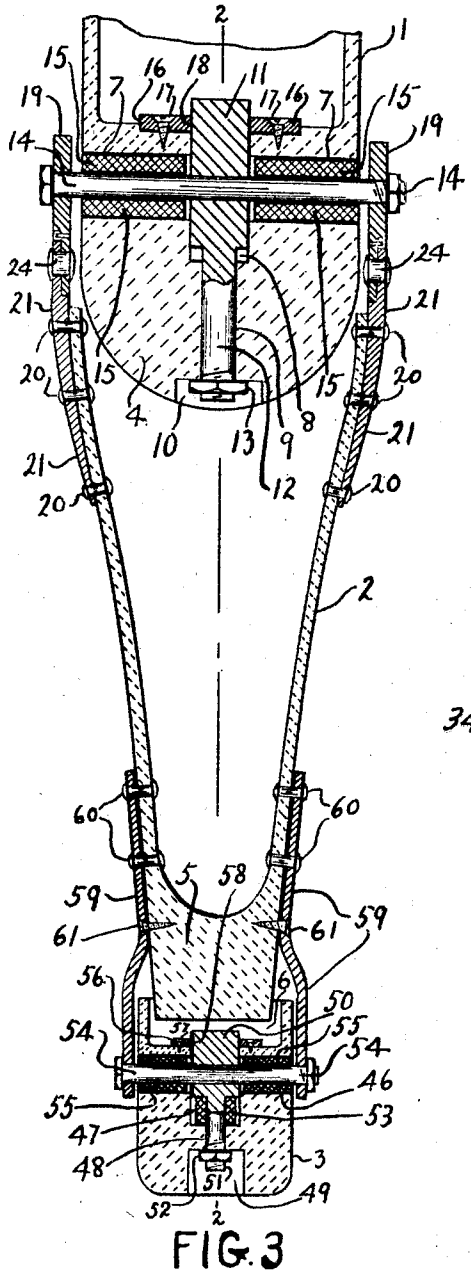

FIG. 3

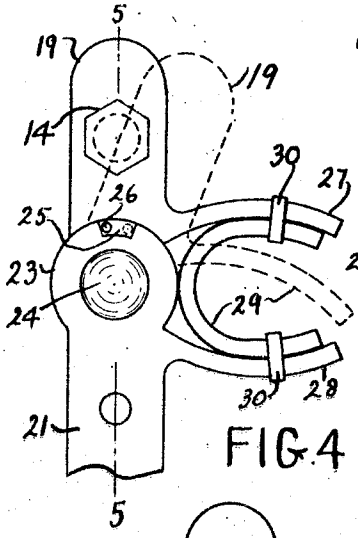

FIG. 4

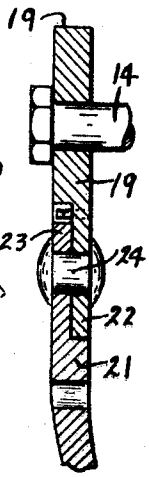

FIG. 5

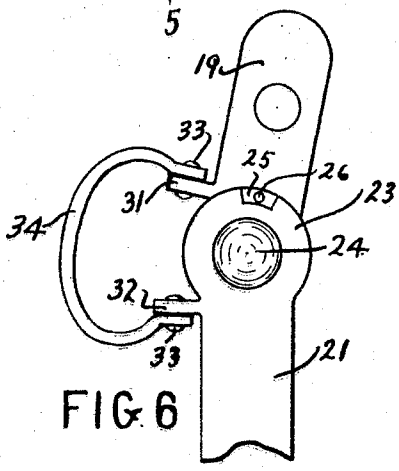

FIG. 6

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Patented Sept. 8, 1925. 1,552,869

UNITED STATES PATENT OFFICE.

JAMES NEVIN, OF HAMILTON, ONTARIO, CANADA.

ARTIFICIAL LEG.

Application filed April 19, 1924. Serial No. 707,645.

To all whom it may concern:

Be it known that I, JAMES NEVIN, a subject of the King of Great Britain, and a resident of the city of Hamilton, in the county of Wentworth, in the Province of Ontario, Dominion of Canada, have invented certain new and useful Improvements in Artificial Legs, of which the following is a specification.

My invention relates to improvements in artificial legs and the object of the invention is to provide a leg which may be worn with the maximum of comfort and which will operate more naturally and will approximate more closely to the action of the human leg than artificial legs hitherto used, thus enabling the wearer to walk with a more natural and lifelike stride and also relieving the hip joints of a great part of the strain usually imposed thereon by the use of an artificial leg. Other objects will appear in the course of the following specification.

My invention consists of a novel form of joint for artificial legs, all as hereinafter more particularly described and illustrated in the accompanying drawings in which:—

Fig. 1 is a side elevation of an artificial leg constructed according to my invention, a portion of the toe of the foot being broken away.

Fig. 2 is a central vertical section through my leg taken on the line 2—2 of Fig. 3.

Fig. 3 is a vertical section taken on the line 3—3 of Figs. 1 and 2.

Fig. 4 is a side elevation of a resilient toggle joint used in my invention, a portion of the lower arm thereof being broken away and a second position of the upper arm being indicated in broken lines.

Fig. 5 is a section taken on the line 5—5 of Fig. 4.

Fig. 6 is a side elevation of a modified form in which the resilient toggle joint may be made.

In the drawings like characters of reference indicate corresponding parts in the various views.

In the form of my invention illustrated 1 indicates the thigh section of an artificial leg, 2 the shank section and 3 the foot.

The lower portion of the thigh 1 is solid and constitutes the knee block 4, while the lower end of the shank 2 is closed at 5 to provide a bearing surface for the foot.

The upper side of the foot 3 is recessed at 6 to receive and permit free operation therein of the lower end of the shank 2.

The knee block 4 is provided with a transverse passage 7 extending therethrough and with a rectangular recess 8 extending downwardly thereinto from the top, said recess intersecting intermediately and perpendicularly the passage 7.

The rectangular recess 8 extends only partially through the depth of the knee block 4 and centrally from the bottom thereof a circular passage 9 extends downwardly, terminating at the bottom of the knee block in an enlarged recess 10, the purpose of which will presently appear.

A crosshead 11 is slidably mounted within the rectangular recess 8 and carries, extending from its bottom end, a bolt 12 which extends through the circular passage 9 in the knee block. The lower end of this bolt carries a nut 13 which lies within the enlarged recess 10.

A knee bolt 14 extends through the transverse passage 7 in the knee block and is freely journalled within the crosshead 11.

Within the passage 7 are mounted resilient liners 15, of rubber or other suitable material, which support and provide a resilient bearing for the knee bolt 14. In this way the knee bolt is resiliently journalled within the knee block, or in other words within the thigh section 1.

In order to provide a better guide for the crosshead 11 and insure free sliding thereof and also to prevent excessive wear of the knee block thereby, a metal guide plate 16 is secured upon the upper face of the knee block by screws 17 and is provided with a rectangular orifice 18 through which the crosshead passes.

The knee bolt 14 projects beyond either side of the knee block 4 and mounted upon each of these projecting ends is an arm 19.

Rigidly secured at either side of the shank leg section 2 by rivets 20 and projecting upwardly therefrom is an arm 21.

The lower ends of the arms 19 and the upper ends of the arms 21 are formed into opposed circular lugs 22 and 23 respectively of reduced thickness, which lugs are pivotally connected by pivots 24. (See Figs. 4 and 5.)

An arc-shaped portion 25 is cut away at the top of the lug 23 of the lower arm 21,

(see Figs. 4 and 5) and a pin 26 is carried by the lug 22 and projects into said recess, The purpose of this will be explained hereinafter.

Reference will now be made particularly to Figs. 1, 2 and 4.

Carried by the upper and lower arms 19 and 21 are rearwardly disposed opposed arcuate extensions 27 and 28 respectively.

Mounted between each pair of these extensions 27 and 28 is a spring 29 which is held against disengagement in any suitable manner such for instance as the clips 30.

Referring now to Fig. 6, a modified construction is shown in which the upper and lower arms 19 and 21 are provided with forwardly disposed extensions 31 and 32 respectively and secured to these extensions by rivets 33 is a spring 34.

Pivotally mounted about a cross shaft 35 within the shank leg section is a bell crank lever 36 the arms of which are indicated by the numerals 37 and 38.

A cross shaft 39 is mounted within the shank leg section and mounted thereon is a resilient cushion 40 of rubber or other suitable material.

The knee block 4 is provided at the rear thereof with a notch 41 into which the upper end of the arm 38 of the bell crank lever engages.

The upper face of this notch is preferably provided with a resilient cushion 42.

The bell crank lever is normally maintained in the position illustrated in full lines in Fig. 2 by means of a spring 43, in which position the arm 37 rests upon the cushion stop 40 and the upper end of the arm 38 lies within the notch 41.

It will thus be seen that the element 40 constitutes a cushion stop for the bell crank lever.

The length of the arm 38 of the bell crank lever is such that clearance is provided at A between the upper end thereof and the top of the notch 41 in the knee block to permit a certain freedom of relative movement between the thigh and shank leg sections, as will hereinafter be explained.

The arm 38 of the bell crank lever carries a hand grip 44 to permit manual swinging of the bell crank lever outwardly into the broken line position shown in Fig. 2, the purpose of which will appear hereinafter. The shank portion 2 is provided with an orifice 45 to permit passage of the arm 38 outwardly.

The foot 3 at the ankle is provided with a transverse passage 46 extending therethrough and with a rectangular recess 47 extending downwardly thereinto from the top, said recess intersecting intermediately and perpendicularly the passage 46.

The rectangular recess 47 extends only partially through the depth of the foot and centrally from the bottom thereof a circular passage 48 extends downwardly terminating at the bottom of the foot in an enlarged recess 49, the purpose of which will presently appear.

A crosshead 50 is slidably mounted within the rectangular recess 47 and carries, extending from its bottom end, a bolt 51 which extends through the circular passage 48 in the foot. The lower end of this bolt carries a nut 52 which lies within the enlarged recess 49.

Carried upon the bolt 51 and lying within the rectangular recess 47 between the bottom of the crosshead 50 and the bottom of said recess is a resilient cushion 53 made of rubber or other suitable material.

An ankle bolt 54 extends through the transverse passage 46 in the foot and is freely journalled within the crosshead 50.

Within the passage 46 are mounted resilient liners 55, of rubber or other suitable material, which support and provide a resilient bearing for the ankle bolt 54. In this way the ankle bolt 54 is resiliently journalled within the foot 3.

In order to provide a better guide for the crosshead 50 and insure free sliding thereof and also to prevent wear of the foot thereby, a metal guide plate 56 is secured upon the upper face of the foot by screws 57 and is provided with a rectangular orifice 58 through which the crosshead 50 passes.

The ankle bolt 54 projects beyond either side of the foot and mounted upon each of these projecting ends is a side iron 59, the upper end of which is rigidly secured to the shank leg section by rivets 60 and screws 61. The two side irons are secured at opposite sides of the shank leg section, and connect the foot thereto.

62 is a resilient cushion mounted to co-act between the foot and the shank leg section at the rear and 63 is a further resilient cushion mounted to co-act between the foot and a downwardly disposed nose 64 formed at the front of the shank leg section.

The construction and operation of my invention is as follows:

Consider first the knee joint.

In the human leg, in the act of walking, there is a free bending of the leg at the knee-joint and therefore, in order to approximate as closely as possible to the natural stride, it is essential that the knee-joint in an artificial leg shall be as flexible as possible.

In artificial legs hitherto used the thigh and shank sections have been connected by a single knee bolt and it has been found that with this type of joint it is impossible to approximate, with any degree of closeness, the free and limber action of the human knee, with the result that a very stiff and awkward stride is unavoidable and also

very severe strain is placed upon the hip-joint and muscles which is very tiresome and painful.

It is with a view of overcoming these defects that I have devised my improved joint and I have accomplished this by using, in conjunction with a novel and resilient manner of mounting the knee-bolt and auxiliary to the knee-bolt, a resilient toggle joint connecting the knee-bolt to the shank leg section.

In the act of walking, the weight of the wearer is transferred from the thigh 1 to the knee-bolt 14 and, since this knee-bolt is journalled between the resilient liners 19, it will have a slight freedom of reciprocation within the knee-block 4 due to the compression of these liners. This freedom of reciprocation will be assured by the cross-head 11 which will reciprocate in its guides in the knee-block.

It will thus be apparent that the knee-bolt is resiliently journalled within the knee-block.

In order to provide a geminating or double-jointed action at the knee and thus render possible a more natural and free stride and also to relieve the hip-joint and muscles of the constant strain caused by a rigid stride, I connect the knee-bolt to the shank leg section by a peculiar form of resilient toggle joint, the action of which will now be described.

This toggle joint comprises the upper short arms 19 which are mounted upon the ends of the knee-bolt 14, and the lower long arms 21 which are rigidly secured upon the shank leg section.

Each pair of these arms 19 and 21 are pivotally connected by the pivot pin 24 as previously described.

In the act of taking a stride, the weight of the body is transferred from the knee-bolt 14 to the short arms 19 and these are free to turn about the pivots 24, this turning being resisted by the springs 29, which are of sufficient strength to give the desired resiliency to the joint.

In this way a very much more free, comfortable, and natural stride is possible than is otherwise obtainable.

In order to limit the degree of movement of the toggle within desired limits, I provide stops therefor consisting of the arc-shaped recesses 25 in the lugs 23 of the lower arms 21 and the pins 26 operating therein and carried by the upper short arms 19.

The recesses 25 are of such length and are so positioned that the upper short arms 19 cannot turn forwardly beyond the position in which they are in alignment with the lower long arms 21 (see full lines in Fig. 4) as at this point the pins 26 engage the front walls of the recesses. Also the pins 26 come into engagement with the rear ends of the recesses 25 when the thigh has assumed an oblique position (see broken line position in Fig. 4) in which it is at a position of desired maximum permissible angularity to the shank leg section, against the resistance of the springs 29.

The extent of this angulation of the toggle is arranged to give the desired freedom for comfortable and natural walking.

A further advantage of the stop for limiting the rearward angulation of the toggle lies in the fact that should the springs 29 break or become disengaged, it would still be possible to walk on the leg until the damage could be repaired.

In order that walking shall be possible at all, it is of course necessary that a positive stop be provided for normally limiting the rearward rotation of the thigh about the knee-bolt when walking and this is provided by a releasable lock consisting of the bell crank lever 36, the operation of which will now be described.

Normally the bell crank lever 36 is held in the full line position shown in Fig. 2 in which the lower arm 37 is resting against the stop 40 and the upper arm 38 lies within the notch 41.

From an examination of Fig. 2 it will be apparent that, as the thigh 1 turns rearwardly about the knee-bolt 14, the upper wall of the notch 41 will approach and finally strike against the arm 38 of the lever, after which no further turning of the thigh in that direction will be possible.

In order that there shall be sufficient freedom of motion allowed at the knee-joint to accomplish the geminating action in walking above described, the length of the arm 38 of the bell crank lever is such that a clearance is provided at "A" between the top of the lever and the top of the notch 41. The extent of this clearance will be arranged to permit the desired freedom of motion at the knee-joint.

In order to further provide resiliency at the knee and to permit a more silent operation, the cushions 40 and 42 (see Fig. 2) are provided.

From the foregoing it will be apparent that as long as the bell crank lever is in its normal position as illustrated in Fig. 2, the thigh cannot assume a greater angularity to the shank leg section than is permitted thereby and therefore when it is desired to sit down, the bell crank lever must be swung rearwardly out of engagement within the notch 41.

This is conveniently accomplished manually by means of the hand grip 44.

The disengaged position of the lever is shown in broken lines in Fig. 2 and it will be evident that, when in this position, the thigh can be turned rearwardly upon the knee-

bolt 14 to any desired degree, thus enabling the wearer to conveniently assume the sitting position.

Immediately the standing position is again assumed, the lever is automatically thrown into its normal engaged position within the notch 41 by the spring 43.

The operation of my improved joint at the ankle is much the same as that already described for the knee except that no toggle action is necessary.

The weight is carried to the ankle-bolt 54 through the side irons 59.

This ankle-bolt is resiliently journalled within the foot between the resilient liners 55 in the same manner as the knee-bolt 14 and therefore the compression of these liners will permit a slight reciprocation of the ankle-bolt within the foot.

The ankle-bolt is journalled in the crosshead 50, which crosshead slides in the guide plate 56 as is the case with the crosshead 11 at the knee-joint.

A resilient cushion 53 is located beneath the crosshead 50.

This construction at the ankle-joint will permit a certain resilient vertical motion of the foot 3 with respect to the shank leg section 2, which will enable the act of walking to be carried out in a more natural and comfortable manner.

A beneficial result of my invention resides in the fact that, since it enables a more comfortable and natural operation of the leg, there is much less likelihood of stumbling or falling, as so often happens with a leg in which a stiff and awkward stride is forced upon the wearer.

In Figs. 1, 2, and 4 I have illustrated one manner in which the resiliency of the toggle-joint may be obtained, namely by means of the springs 29 mounted to be compressed between the rearwardly disposed extensions 27 and 28, but other constructions might be used to obtain this resiliency, such for instance, as the springs 34 mounted fo rexpansion between the forwardly disposed extensions 31 and 32, and I intend that any such equivalent construction for obtaining this resiliency shall fall within the scope of my present invention.

It may be noted that I have neither illustrated nor described the manner in which the forward turning of the thigh upon the knee-bolt 14 beyond the vertical is prevented but since this is old and well known in the art and forms no part of my invention, it has not been thought necessary to refer to it, as it would only tend to complicate the drawings and obscure the disclosure of my real invention.

There are numerous well known ways in which this is provided for.

Many modifications may be made in my invention without departing from the spirit thereof or the scope of the claims and therefore the forms shown are to be taken as illustrative only and not in a limiting sense.

From the foregoing it will be evident that I have devised valuable improvements in artificial legs which will prove of great benefit to those persons who have to make use of such appliances.

What I claim as my invention is:

1. In an artificial leg the combination with two leg sections to be connected, of a bolt connecting said leg sections and resiliently journalled in one of said sections, a crosshead freely mounted upon said bolt and slidable in said leg section in which the bolt is resiliently journalled.

2. In a knee-joint for an artificial leg, the combination with the thigh and shank leg sections connected thereby, of a bolt extending transversely through and resiliently journalled in the thigh section, a crosshead slidably mounted within the thigh section and freely mounted upon said bolt intermediately of its length, an arm mounted upon each end of said bolt, a second arm rigidly secured upon each side of the shank leg section, the lower end of each of the first mentioned arms pivotally connected to the upper end of one of the second mentioned arms.

3. In a knee-joint for an artificial leg, the combination with the thigh and shank leg sections connected thereby, of a bolt extending transversely through and resiliently journalled in the thigh section, a crosshead slidably mounted within the thigh section and freely mounted upon said bolt intermediately of its length, an arm mounted upon each end of said bolt, a second arm rigidly secured upon each side of the shank leg section, the lower end of each of the first mentioned arms pivotally connected to the upper end of one of the second mentioned arms, and a spring operatively co-acting between each pair of connected arms.

4. In a knee-joint for an artificial leg, the combination with the thigh and shank leg sections connected thereby, of a bolt extending transversely through and resiliently journalled in the thigh section, a crosshead slidably mounted within the thigh section and freely mounted upon said bolt intermediately of its length, an arm mounted upon each end of said bolt, a second arm rigidly secured upon each side of the shank leg section, the lower end of each of the first mentioned arms pivotally connected to the upper end of one of the second mentioned arms, a spring operatively co-acting between each pair of connected arms, and stop means co-acting between each pair of connected arms for limiting the relative rotation thereof about their pivotal connection.

5. In an artificial leg the combination, with the thigh and shank leg sections and

the knee-joint connecting said sections, of a releasable lock co-acting between the thigh and shank sections, comprising, a bell crank lever pivotally mounted within the shank section, one arm of said lever engaging a stop in the shank section and the other arm engaging within a notch in the thigh section, a spring normally maintaining such engagement, and means permitting swinging of the bell crank lever out of such engagement.

6. In an artificial leg the combination, with the thigh and shank leg sections and the knee-joint connecting said sections, of a releasable lock-co-acting between the thigh and shank sections, comprising, a bell crank lever pivotally mounted within the shank section, one arm of said lever engaging a cushion stop in the shank section and the other arm engaging within a notch in the thigh section, a cushion within the notch adapted to engage the bell crank lever, a spring normally maintaining the lever in engagement with the stop in the shank section, and means permitting swinging of the bell crank lever out of engagement with the notch and stop.

7. In an artificial leg the combination, with the thigh and shank leg sections, and the knee-joint connecting said sections, of a releasable lock co-acting between the thigh and shank sections, comprising, a bell crank lever pivotally mounted within the shank section, one arm of said lever engaging a stop in the shank section and the other arm engaging within a notch in the thigh section, a spring normally maintaining such engagement, and means permitting swinging of the bell crank lever out of such engagement, the thigh having a limited degree of freedom of movement about the knee-joint when the lever is engaged within the notch.

8. In an artificial leg the combination with two leg sections to be connected, of a bolt connecting said leg sections, one of said leg sections provided with a transverse passage extending therethrough, said leg section formed with a recess therein disposed perpendicularly to and intersecting intermediately the aforesaid passage, a metallic crosshead slidably mounted within said recess, a metal plate secured to the leg section in which the crosshead is mounted, said plate provided with an orifice through which the crosshead extends, the bolt extending through the transverse passage and journalled within the crosshead, and a resilient lining within the transverse passage forming a bearing within which the bolt is journalled.

JAMES NEVIN.