Nov. 11, 1947. A. R. ROCHE 2,430,584

ARTIFICIAL LEG

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Fig. 1.

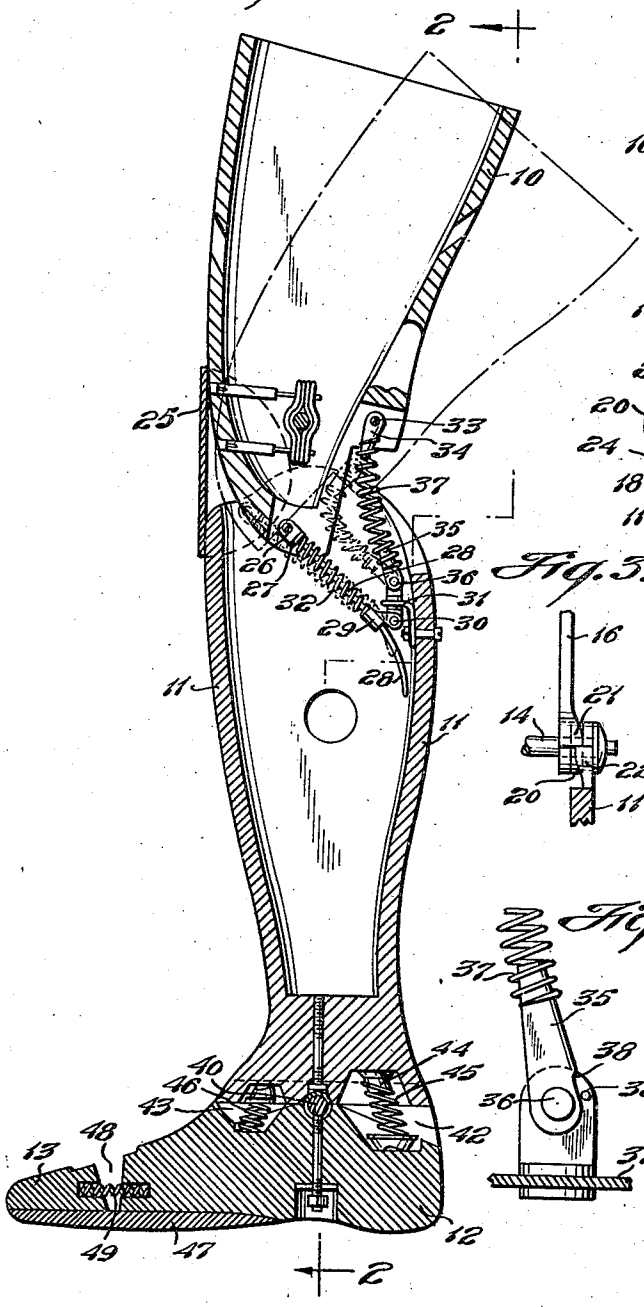

Fig. 2.

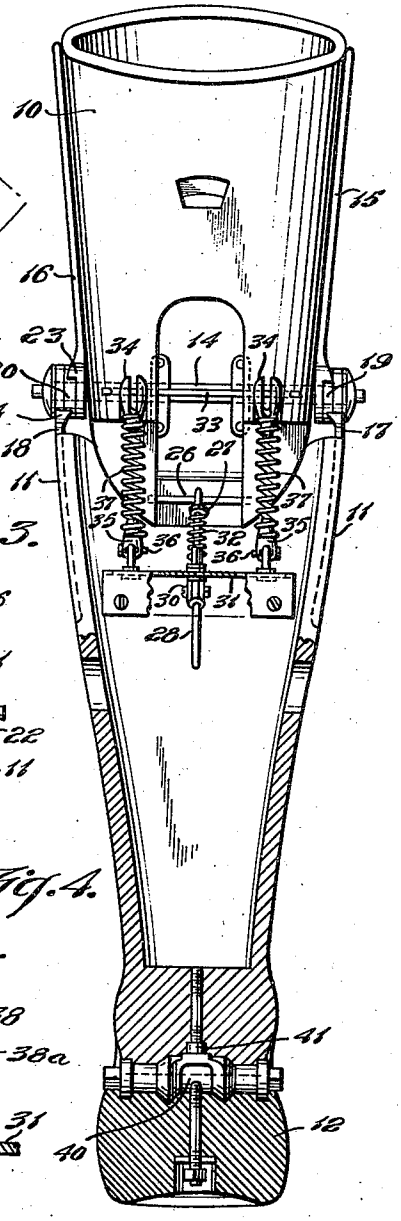

Fig. 3.

Fig. 4.

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ARTIFICIAL LEG

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3 Claims. (Cl. 3—2)

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This invention relates to improvements in artificial legs.

A primary object of the invention is to provide an improved artificial leg wherein there is a novel construction of knee action so arranged that when weight is imposed thereon when the leg is in a vertical or upright position, any tendency for the leg to buckle is effectively avoided and when the foot of the leg is lifted from the ground, the lower leg portion will be started on a rearward swing relatively to the upper leg portion. As the leg is swung forwardly a novel arrangement of springs causes the lower leg portion to return to position in alignment with the upper leg portion and into a position capable of supporting the weight of the user without buckling.

Another object of the invention is to provide an artificial leg having a novel ankle and toe arrangement which is so constructed that when incorporated in a leg, particularly with the leg embodying the novel knee action herein disclosed, will enable the user to walk in a natural manner.

With the foregoing and other objects in view, which will be made manifest in the following detailed description and specifically pointed out in the appended claims, reference is had to the accompanying drawings for an illustrative embodiment of the invention, wherein:

Figure 1 is a longitudinal vertical section through the improved artificial leg embodying the present invention;

Fig. 2 is a sectional view taken substantially upon the line 2—2 upon Fig. 1 in the direction indicated; and

Figs. 3 and 4 are partial views illustrating details of construction.

Referring to the accompanying drawings wherein similar reference characters designate similar parts throughout, the improved artificial leg consists of an upper leg portion 10, a lower leg portion 11, a foot portion 12, and a toe portion 13. The upper and lower leg portions are preferably hollow so as to reduce weight. They are hingedly connected together by a transversely extending shaft 14. In the preferred form of construction the upper leg portion has side irons 15 and 16 rigidly secured thereto and the lower leg portion 11 has corresponding side irons embedded in the walls thereof indicated at 17 and 18. Anti-friction bearings 19 and 20 are interposed between corresponding side irons and around the shaft 14.

As will be appreciated by those skilled in the art, the axis of the shaft 14 should be slightly inclined so that the inner end of the shaft is

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somewhat higher than the outer end of the shaft whereby the lower leg will swing relatively to the upper leg in a manner corresponding to the axis of movement of a natural knee. Consequently, depending upon whether the leg is a left leg or a right leg, the position of the shaft 14 should be slightly inclined, as above stated.

At the forward sides of the side irons there are mutually engageable shoulders 21 and 22 (see Fig. 3) which will limit forward swinging movement of the upper leg portion to a vertical position or upright position with relation to the lower leg portion. In a similar manner complementary shoulders 23 and 24 are formed on the rear sides of the side irons to ultimately limit bending or turning movement of the upper leg portion relatively to the lower leg portion. The lower end of the upper leg portion extends downwardly into the top of the lower leg and a knee cap 25 preferably formed of one or more layers of heavy felt is secured at its upper edge to the upper leg portion and is suspended therefrom over the break between the upper and lower leg portions. A feature of the invention concerns the springs employed that affect the movements of the leg portions with relation to each other. Adjacent the bottom of the upper leg portion there is pivoted as at 26 a clevis 27 to which is secured a guide stem 28. This guide stem slidably extends through a ferrule 29 that is pivoted as at 30 to the underside of a bracket 31 that is mounted within the lower leg portion on the back wall thereof. A coil compressison spring 32 is compressed slightly about the guide rod 28 between the ferrule 29 and the clevis 27. This compression spring will normally urge the lower leg portion to swing rearwardly with relation to the upper leg portion. Adjacent the back of the upper leg portion 10 and near the lower end thereof there is a transversely extending rod 33 that is pivoted in the upper leg portion and carries downwardly extending tapered spring seats 34. Complementary tapered spring seats 35 are pivotally mounted as at 36 upon the bracket 31. Compression springs 37 are compressed between these spring seats and the spring seats partially enter their respective ends of these springs. These springs are so arranged that when the upper leg portion bends with relation to the lower leg portion as indicated by dotted lines on Fig. 1, the coil springs will tend to bend or buckle as indicated by dotted lines. By this arrangement after the knee of the leg has started to bend, causing the springs to buckle, the springs will offer a minimum resistance to continued bending. However, as the upper and

lower leg portions start returning to their normal or upright positions, the springs 37 tend to straighten and in straightening they exert their maximum effort toward maintaining the portions of the leg in aligned or upright positions with relation to each other. Consequently, with this arrangement it will be appreciated that in walking, when the leg is lifted from the surface of the ground, the lower compression spring 32 will be effective to start a rearward swinging of the lower leg portion thus causing the springs 37 to begin to buckle. After buckling of the springs 37 has started, continued bending of the knee of the leg is relatively easy. As the leg is then swung forwardly in taking a step the momentum of the lower leg tends to return it to the aligned position with the upper leg and unbuckling or straightening of the springs 37 commences. As these springs approach their straight or full line position, as illustrated in Fig. 1, they become more and more effective to return the lower leg to a position in alignment with the upper leg. During this movement of the knee of the leg the guide rod 28 merely slides through the pivoted ferrule 29 enabling the spring 32 to compress and expand and serving at all times to maintain this spring in proper position.

As is illustrated in Fig. 4, the lower spring seats 35 are provided with stops 38 engageable with stop pins 38a on the bracket 31 so that these spring seats may never pivot rearwardly but will be maintained in a position slightly inclined forwardly so that the springs 37 are constantly slightly flexed toward their buckling position.

At the bottom of the lower leg the foot portion 12 is hingedly connected to the lower leg portion 11. To this end the foot portion may have a T-iron 40 mounted thereon which is received in a knuckle providing member 41 attached to the bottom of the lower leg portion. Rearwardly of this hinge connection the foot portion is recessed as at 42 to permit of rearward swinging movement of the lower leg portion 11 with relation to the foot. A similar recess at 43 permits of forward swinging movement of the lower leg 11 with relation to the foot. Opposed recesses are formed in the foot and in the lower leg portion 11 above and below these clearance spaces and these recesses accommodate spring seats 44 for compression springs 45 and 46. These compression springs permit the lower leg portion to rock either forwardly or rearwardly with relation to the foot 12 but normally urge the foot into a predetermined position with relation to the lower leg. The toe portion 13 is attached to the foot 12 by means of a section of leather, composition or the equivalent, indicated at 47. This leather, while relatively stiff, permits of some flexing of the toe portion relatively to the foot. Such movement is provided by the clearance space indicated at 48. One or more compression springs 49 extend across the clearance space 48 and are recessed at their ends in the toe and foot respectively. These compression springs urge the toe 13 to remain in proper position extending forwardly of the foot portion but permit of flexing of the toe with relation to the foot when such action is required.

From the above described construction it will be appreciated that the improved artificial leg is so designed as to enable walking in a natural manner by amputees. The mechanism at the knee joint of the leg is such that when the leg is lifted from the surface of the ground so as to be suspended, the lower compression spring 32 is

highly effective to swing the lower leg portion rearwardly. During this rearward swinging movement the compression springs 37 tend to buckle and thus resistance to the rearward swinging movement decreases as the movement progresses. When the leg is swung forwardly the compression springs 37 tend to straighten into the full line position shown in Fig. 1, and as the lower leg portion approaches the limit of its movement occasioned by the stops 21 and 22 mutually engaging, these springs exert their maximum effort to retain the lower leg in aligned position with the upper leg 10. Rocking of the leg with relation to the foot portion is provided by the ankle pivot and the compressible springs and the arrangement at the connection of the toe is such as to simulate natural foot action.

Various changes may be made in the details of construction without departing from the spirit and scope of the invention as defined by the appended claims.

I claim:

1. In an artificial leg, upper and lower leg portions pivotally connected together for relative swinging movement therebetween, a compression spring connecting the upper leg portion to the lower leg portion urging the upper leg portion to assume a bent position relative to the lower leg portion, and compression springs arranged behind the pivot urging the upper leg portion to assume an upright position with relation to the lower leg portion, the last mentioned springs being arranged to buckle when the upper leg portion swings relatively to the lower leg portion.

2. In an artificial leg, upper and lower leg portions pivotally connected together for relative swinging movement therebetween, a guide stem pivotally mounted on the lower end of the upper leg portion, a ferrule pivotally mounted within the lower leg portion through which the guide stem is slidable, a compression spring disposed about the guide stem urging the upper and lower leg portions into bent positions with relation to each other, compression springs arranged behind the pivot, spring seats for said compression springs pivotally mounted upon the upper leg portion and lower leg portion respectively, means limiting rotary movement of some of the spring seats, the last mentioned compression springs being arranged to buckle when the upper leg portion swings relatively to the lower leg portion and to straighten when the upper leg portion assumes a position in alignment with the lower leg portion.

3. In an artificial leg, upper and lower leg portions pivotally connected together for relative swinging movement therebetween, a guide stem pivotally mounted on the lower end of the upper leg portion, a ferrule pivotally mounted within the lower leg portion through which the guide stem is slidable, a compression spring disposed about the guide stem urging the upper and lower leg portions into bent positions with relation to each other, compression springs arranged behind the pivot, spring seats for said compression springs pivotally mounted upon the upper leg portion and lower leg portion respectively, means limiting rotary movement of some of the spring seats, the last mentioned compression springs being arranged to buckle when the upper leg portion swings relatively to the lower leg portion and to straighten when the upper leg portion assumes a position in alignment with the lower leg portion, and means limiting forward swinging movement

of the upper leg portion with relation to the lower leg portion.

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