Nov. 14, 1950 H. SARTIN 2,529,968

MECHANISM FOR ARTIFICIAL LEGS

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Fig. 1

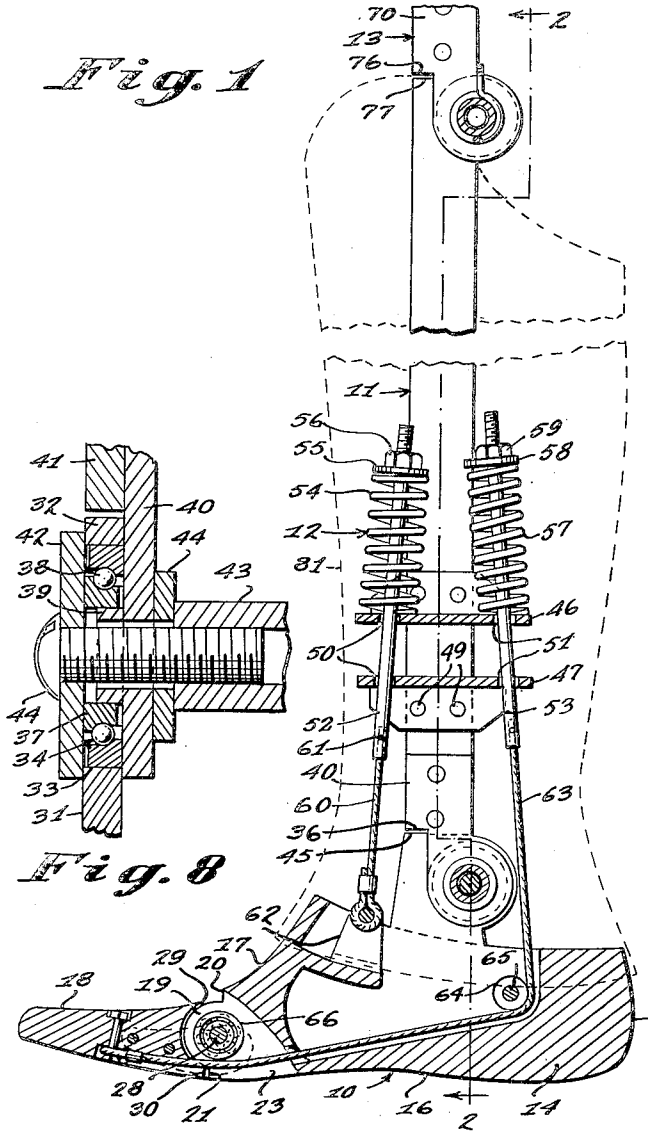

Fig. 8

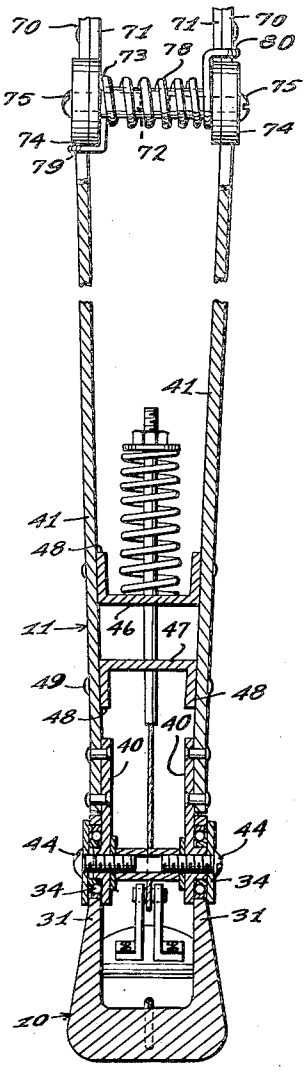

Fig. 2

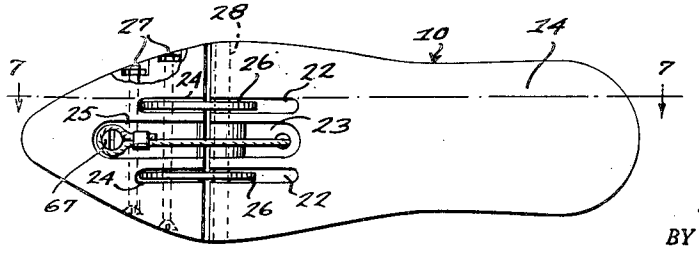

Fig. 3

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Fig. 4

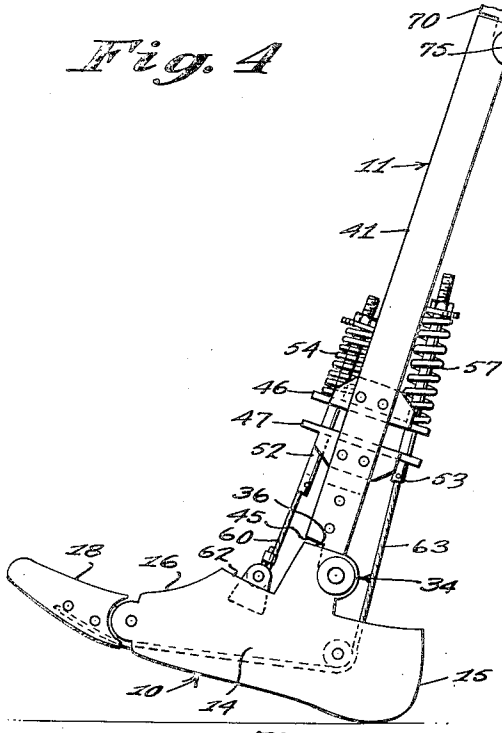

Fig. 5

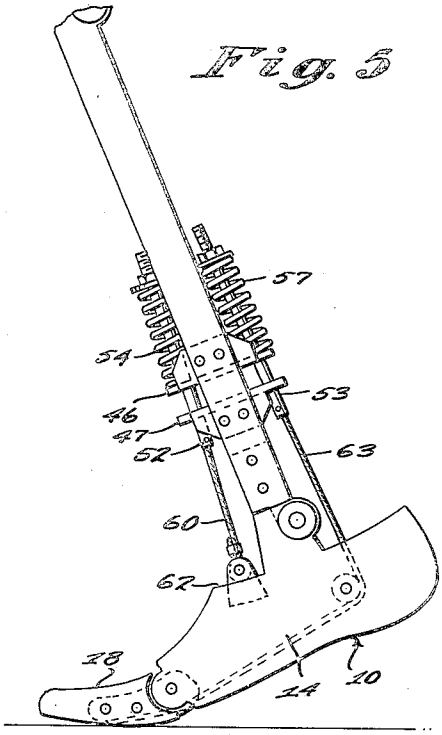

Fig. 6

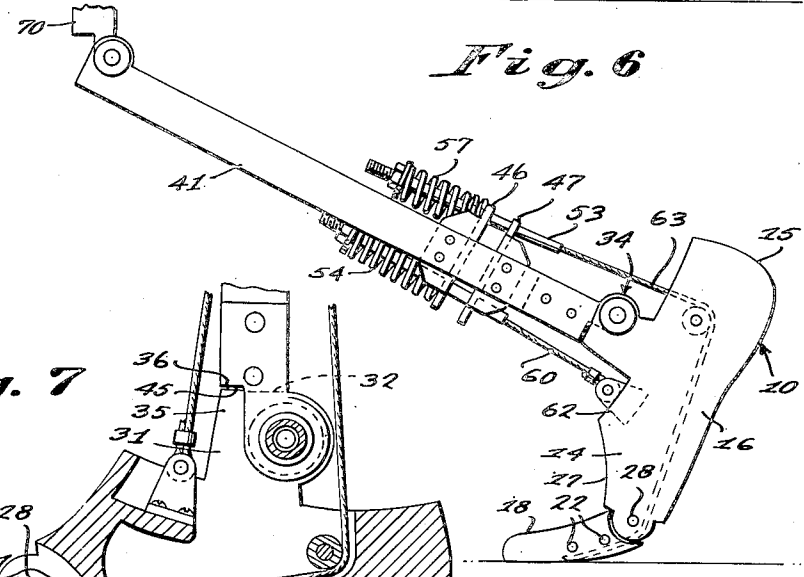

Fig. 7

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UNITED STATES PATENT OFFICE

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MECHANISM FOR ARTIFICIAL LEGS

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Application June 15, 1948, Serial No. 33,192

4 Claims. (Cl. 3—6)

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This invention relates to improvements in mechanism for artificial legs, and more particularly to an improved, spring-operated mechanism for controlling the foot and knee action of an artificial leg.

It is among the objects of the invention to provide an improved internal mechanism for an artificial leg which mechanism supports all of the weight and other forces imposed on the leg and carries the hollow shell for giving shape and a substantially normal appearance to the leg, which includes a two-part foot piece and upwardly-extending strut bars pivotally connected to the foot piece and is spring operated to give a normal walking action to the foot piece, which permits relative movement of the two parts of the foot piece under pressure to substantially the same extent as the movement of a natural foot, and positively returns the two parts of the foot piece to a substantially straight condition when the pressure is relieved, which will not lock or bind in operation, can be readily modified to suit the requirements of wearers of different heights and weights, is adjustable to compensate for moderate variations in weight and other factors, and which is simple, strong and durable in construction, economical to manufacture, extremely light in weight, neat and attractive in appearance, and closely simulates the appearance and action of a natural leg.

Other objects and advantages will become apparent from a consideration of the following description and the appended claim in conjunction with the accompanying drawings, wherein:

Figure 1 is a longitudinal, medial cross-section of an artificial leg mechanism illustrative of the invention;

Figure 2 is a longitudinal cross-section taken substantially on the line 2—2 of Figure 1, and in a plane substantially perpendicular to the plane of the cross-section illustrated in Figure 1;

Figure 3 is a bottom plan view of the foot piece of the mechanism, a portion being broken away and shown in cross-section to better illustrate the construction thereof;

Figures 4, 5 and 6 are side elevations of the improved artificial leg mechanism showing the mechanism in three different operative positions; and

Figure 7 is a longitudinal cross-section of the foot piece taken substantially on the line 7—7 of Figure 3.

With continued reference to the drawings, the improved artificial leg mechanism comprises, in general, a two-part foot piece 10, a shank 11 pivotally connected at its lower end to the foot piece, spring mechanism 12 carried by the shank and operatively connected at its lower end to the foot piece, and a thigh boot 13 pivotally connected to the upper end of the shank 11.

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The axes of the pivotal connections between the two parts of the foot piece, between the lower end of the shank and the foot piece, and between the lower end of the thigh boot and the upper end of the shank are all substantially parallel to each other.

The foot piece 10 comprises a hollow rear part 14 providing externally thereof a heel 15, an arch 16, and an instep 17 and a toe part 18 pivotally connected at its rearward end to the front end of the rear part 14. The front end of the rear part 16 of the foot piece is provided with a transversely-extending, partly cylindrical end surface 19 and with upper and lower, transversely-extending radial shoulders 20 and 21 substantially diametrically opposite each other. This rear part is also provided with two spaced-apart, substantially parallel slots 22 extending through the cylindrical surface 19 and the shoulders 20 and 21 and with an intermediate slot or groove 23 between the two slots 22.

The toe part 18 is provided in its rear end with a transversely-extending, cylindrical concavity of substantially the same diameter as the partly-cylindrical extension 19 on the rear part 16 of the foot piece and with spaced-apart, substantially parallel slots 24 and an intermediate groove 25 between the slots 24. A pair of flat hinge tongues 26 is rigidly secured, one in each slot 24 of the toe part by suitable means, such as the two pins 27 extending transversely through the toe part and through the apertured end parts of the tongues 26 received in the slots 24. These tongues extend into corresponding slots 22 in the rear part 16 and have apertures near their rearward ends and a pivot pin 28 extends transversely through the rear part 16 of the foot piece near the front end of the latter and through the rearward ends of the tongues 26 to pivotally connect the toe part 18 to the rear part 14 of the foot piece 10. The toe part is provided with an upper shoulder 29 and a lower shoulder 30 disposed one at each edge of the partly-spherical, transverse concavity in the rearward end thereof, and these shoulders cooperate with the upper and lower shoulders 20 and 21 on the rear part of the foot piece to limit the extent of relative pivotal movement between the toe part 18 and the rear part 16 of the foot piece. This movement is of such an extent, as illustrated in Figures 4, 5 and 6, that the toe part

may move upwardly from a position in which it is substantially straight with the rear part 14, as illustrated in Figures 1 and 7, to a position in which it is sharply inclined upwardly relative to the rear part, as illustrated in Figure 6, which is substantially equivalent to the flexing of a natural foot between a standing and a kneeling position. It will be noted that the hinge tongues 26 are so shaped that they do not, at any time, protrude below the bottom surface of the foot piece, and are of sufficient cross-sectional area to provide adequate strength for the pivotal joint between the toe part and the rear part of the foot piece.

The hollow rear part 14 of the foot piece is preferably formed of a suitable light-weight metal, such as aluminum or a magnesium alloy, and is provided with a pair of upstanding lugs 31 disposed one at each side of the rear part of the foot piece and transversely opposed to each other. Each of these lugs has on its rearward side and near its upper end a circular eye 32 receiving the annular outer race 33 of an anti-friction ball bearing, generally indicated at 34, and on the forward side of its upper end with an upward extension 35 having an upper end substantially perpendicular to the longitudinal or vertical center-line of the lug and providing an upwardly-facing shoulder 36.

An inner race 37 is circumspatially disposed within the outer race 33 and bearing balls 38 are operatively disposed between the two races. The inner race is carried on the external surface of an apertured, circular boss 39 provided on one side of an arm 40 riveted or otherwise permanently secured to a respective strut bar 41 near the lower end of the latter. The arm 40 overlies both bearing races 33 and 37 at one side thereof, as is clearly illustrated in Figure 8, and a washer 42 overlies the opposite sides of the two races. A tubular spacer 43, internally screw threaded near its opposite ends, is disposed between the two opposed arms 40 substantially concentric with the axis of the two anti-friction bearings 34 and a pair of screws 44 extend one through each washer 42, through the associated anti-friction bearing 34, and through the boss 39 and arm 40 and is threaded into the adjacent end of the spacer 43 to secure the bearing parts together in operative assembly. A thrust washer 44 is preferably interposed between the inner surface of each arm 40 and the adjacent end of the spacer 43 and the inner and outer bearing races are provided with grooves which are asymmetrical in cross-section and somewhat narrower than the space between the arm 40 and washer 42 in which they are received, so that the anti-friction ball bearings may be preloaded or tightened by tightening the respective screws 44 to take up wear in the bearings and eliminate any relative lateral movement of the inner and outer races.

Each strut bar 41 is provided with a lower end surface substantially perpendicular to the longitudinal center-line of the strut bar, a portion 45 of which surface overlies the upwardly-facing shoulder 36 provided on the corresponding lug 31. Both of these shoulders are disposed at the forward side of the axis of the anti-friction bearings 34 and limit the relative pivotal movement between the strut bars 41 and the rear part of the foot piece 14, so that the strut bars cannot swing forwardly relative to the foot piece beyond a position in which a plane including the longitudinal center-lines of both strut bars is substantially perpendicular to a substantially horizontal plane including the longitudinal center-line of the foot piece or, in other words, the strut bars cannot extend forwardly of a substantially vertical position without moving the foot piece when the foot piece is in flat contact with a horizontal supporting surface, this limiting forward position of the strut bars being clearly illustrated in Figure 1. The two strut bars 41 are rigidly secured together at a location spaced above the arms 40 of the anti-friction bearings 34 by a pair of spaced-apart, substantially parallel, transverse plates including an upper plate 46 and a lower plate 47. Each of these plates is provided along opposite edges with upturned ears 48 which contact the inner surfaces of the respective strut bars and are rigidly secured to the strut bars by suitable means, such as the rivets 49. Plates 46 and 47 extend forwardly and rearwardly of the strut bars and are provided near their forward ends with registering apertures 50 and near their rearward ends or edges with registering apertures 51. A pin 52 is slidably mounted in the apertures 50 and extends above and below the two plates 46 and 47 and a similar pin 53 is slidably mounted in the apertures 51. A coiled compression spring 54 surrounds a portion of pin 52 above upper plate 46 bearing at its lower end on the upper surface of the plate 46 and at its upper end against an abutment washer 55 secured on the pin by a nut 56 threaded onto the externally-screw-threaded upper end of the pin. A similar coiled compression spring 57 surrounds the portion of pin 53 above upper plate 46 bearing at its lower end on the upper surface of plate 46 and its upper end against an abutment washer 58 secured on pin 53 by a nut 59 threaded onto the externally-screw-threaded upper end of the pin.

A flexible cable 60 is secured at its upper end to the lower end of pin 52 by any suitable cable-securing means, such as by extending the cable into a longitudinal well provided in the end of the pin and extending a transverse pin 61 through the pin and the cable above the lower end of the pin, and is secured at its lower end by an inverted, U-shaped stirrup 62 to the upper side of the rear part 14 of the foot piece just inwardly of the instep portion 17 of such rear part. With this arrangement the force of spring 54 tends to pull the forward end of the foot piece upwardly until the shoulders 36 and 45 are in contact limiting such upward movement and resiliently resists pivotal movement of the foot piece relative to the strut bars 41 about the axis of pivot bearings 34 in a direction to turn the front portion of the foot piece downwardly and the heel upwardly as occurs when the artificial leg is swung forwardly to begin a new step, as is particularly illustrated in Figure 4. The spring 54 is so adjusted by properly positioning nut 56 that the heel can move upwardly a desired amount under pressure when the leg is in the position illustrated in Figure 4, to cushion the impact of the heel with the supporting surface, and to facilitate the stepping action of the mechanism.

As shown in Figure 4, the shoulders 36 and 45 are separated, spring 54 is compressed, and spring 57 is expanded. A cable 63 is secured at its upper end to the lower end of pin 53 by suitable means, such as described above in connection with the upper end of cable 60, and passes downwardly into the foot piece near the heel 15 thereof, and around a roller 64 mounted in the heel part of the foot piece for rotation about a transversely-extending pin 65. The cable 63 extends forwardly from the roller 64 and under an anti-

friction roller 66 mounted on the pivot pin 28 within the intermediate slot 23 of the forward portion of the rear part 14 of the foot piece and through the groove 25 in the toe part to the forward end of this groove where it is connected to the toe part by suitable means, such as the screw 67.

Spring 57 and cable 63 have the dual function of resiliently holding the heel end of the foot piece up against the force of spring 54 and of resiliently holding the toe part of the foot piece down to its position in which it is substantially straight with the rear part of the foot piece, as illustrated in Figure 7. The toe part is pivotally movable upwardly from its position in which lower shoulders 21 and 30 are in contact, to its position in which upper shoulders 20 and 29 are in contact by compression by spring 57. As soon as the upwardly-turning pressure is released from the toe part, spring 57 will immediately return it to its lower or substantially straight position.

Thigh boot 13 includes two substantially parallel, spaced-apart strut bars 70 to which are secured bearing arms 71, similar in all respects to the arms 40 and secured to the strut bars by suitable rivets. These arms are provided with apertured bosses carrying respective ball bearing inner races and the upper ends of the shank strut bars 41 are provided with circular eyes receiving respectively, the outer races of the two bearings and anti-friction balls are disposed between each inner and outer anti-friction bearing race, as described above. A tubular spacer sleeve 72 is disposed between the arms 71 concentric with the bosses thereon and thrust washers 73 are preferably interposed between the ends of this sleeve and the adjacent surfaces of the arms. A thrust washer 74 overlies the outer sides of each pair of ball bearing races, and a screw 75 extends through each outer washer, each inner race, each arm 71 and each thrust washer 73 and is threaded into the internally screw-threaded end of the tubular spacer to hold the corresponding bearing structure in operative assembly. The inner and outer races are preferably formed in the same manner as the races for the bearings 34, described above, so that the bearings may be tightened or preloaded by tightening the screws 75. Each strut bar 41 is provided on its upper end with a perpendicularly-extending shoulder 76 and each of the upper strut bars 70 is provided on its lower end with a corresponding shoulder 77, these two shoulders being disposed to one side of the axis of the upper anti-friction bearings to provide a knee joint in which the upper and lower strut bars are relatively movable in one direction about the axis of the anti-friction bearing, but have their relative movement in the opposite direction limited to a substantially vertical position in which the upper and lower strut bars are in substantially straight, longitudinal alignment with each other.

A coiled torsion spring 78 surrounds the spacer sleeve 72 and has one end 79 provided with a hook operatively engaging one of the lower strut bars 41 near the upper anti-friction bearing and its other end 80 provided with a hook operatively engaging the upper strut bar at the opposite side of the bearing assembly, this spring serving to resiliently urge the upper and lower strut bars to a substantially straight condition in which the respective shoulders 76 and 77 are in bearing engagement with each other.

A hollow shell 81 of suitable material, such as thin aluminum, surrounds the shank portion of the artificial leg mechanism and is secured to the strut bars 41 and supported thereby, suitable spacers being used, as may be found convenient, to properly position the shell on the internal mechanism. The lower end of this hollow shell overlies the upper portion of the foot piece 10, as is clearly illustrated in Figure 1, so that no gaps will be opened in the artificial leg by movement of the foot piece, as explained above. The thigh boot may be of any desired construction and rigidly secured to the upper strut bar 70 which may be made of any suitable length and shape to accommodate the wearer of the leg.

The two lower strut bars 41 are rigidly secured together by the plates 47 and 48 and by the lower anti-friction bearing assembly and together with these plates and the bearing assembly constitute a unitary shank portion for the leg mechanism.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is, therefore, to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are, therefore, intended to be embraced therein.

What is claimed is:

1. Mechanism for an artificial leg comprising a two-part foot piece, means hingedly connecting the two parts of said foot piece together for relative movement about a substantially transverse axis, a pair of spaced-apart strut bars upstanding from the rear part of said two-part foot piece, means connecting the lower ends of said strut bars to said foot piece for limited pivotal movement about an axis substantially transverse to said foot piece, and spring means carried by said strut bars and operatively connected to said foot piece to resiliently control movement of said foot piece relative to said strut bars and movement of the two parts of said foot piece relative to each other, said means pivotally connecting said two parts of said foot piece comprising a partly-cylindrical, transversely-extending protrusion on the front end of the rear part of said foot piece rotatably received in a partly-cylindrical, transversely-extending socket in the rearward end of the toe part of said foot piece, a pair of transversely-extending shoulders on said rear part disposed one in the upper and one in the lower surface of the latter at the upper and lower edges of said protrusion, a pair of transversely-extending shoulders on said toe part disposed one at the upper and one at the lower edge of said socket and cooperating with said rear-part shoulders to limit movement of said toe part relative to said rear part in both directions, a pair of spaced-apart, substantially parallel hinge tongues secured in said toe part and having apertured ends extending into arm-receiving slots in said rear part, and a pivot pin extending transversely through said rear part and said hinge arms pivotally inter-connecting said foot-piece parts.

2. Mechanism for an artificial leg comprising a two-part foot piece, means hingedly connecting the two parts of said foot piece together for relative movement about a substantially transverse axis, a pair of spaced-apart strut bars upstanding from the rear part of said two-part foot piece, means connecting the lower ends of said strut bars to said foot piece for limited pivotal move-

ment about an axis substantially transverse to said foot piece, and spring means carried by said strut bars and operatively connected to said foot piece to resiliently control movement of said foot piece relative to said strut bars and movement of the two parts of said foot piece relative to each other, said means connecting the lower ends of said strut bars to said foot piece comprising a pair of transversely-opposed lugs upstanding from the rear part of the foot piece and each having in its upper end a circular eye and an end surface providing a shoulder at the side of said eye corresponding to the front end of said foot piece, a pair of bearing arms each having an apertured boss thereon, a bearing outer race in the eye of each lug, a bearing inner race on each boss rotatably received in a corresponding outer race, said bearing arms being secured one to each of said strut bars near the lower ends of the latter, a tubular spacer disposed between said bearing arms concentric with said apertured bosses, a washer at the outer side of each bearing assembly, and a respective screw extending through each outer washer and the corresponding bearing-arm boss and threaded into the adjacent end of the tubular spacer to secure said bearings in operative assembly.

3. Mechanism for an artificial leg comprising a two-part foot piece, means hingedly connecting the two parts of said foot piece together for relative movement about a substantially transverse axis, a pair of spaced-apart strut bars upstanding from the rear part of said two-part foot piece, means connecting the lower ends of said strut bars to said foot piece for limited pivotal movement about an axis substantially transverse to said foot piece, and spring means carried by said strut bars and operatively connected to said foot piece to resiliently control movement of said foot piece relative to said strut bars and movement of the two parts of said foot piece relative to each other, said spring means comprising a pair of spaced-apart supporting plates secured between said strut bars and having aligned apertures therein, a pair of pins slidable in said supporting-plate apertures disposed one at the front and one at the rear side of said strut bars and substantially parallel to the latter, a respective coiled compression spring surrounding each pin above the upper supporting plate, an adjustable spring

abutment on the upper end of each pin, a stirrup secured to the rear part of said foot piece at the front side of said strut bars, a cable connecting said stirrup to the lower end of the pin at the front side of said bars to said stirrup, a roller in the rear part of said foot piece adjacent the heel end thereof, a cable connected to the lower end of the pin at the rear side of said bars, passing under said roller and secured at its opposite end to said toe part of said foot piece adjacent the bottom surface of the latter, and a roller carried by the means hingedly connecting said foot-piece parts together and bearing upon said last-mentioned cable.

4. Mechanism for an artificial leg comprising a two-part foot piece, means hingedly connecting the two parts of said foot piece together for relative movement about a substantially transverse axis, a pair of spaced-apart strut bars upstanding from the rear part of said two-part foot piece, means connecting the lower ends of said strut bars to said foot piece for limited pivotal movement about an axis substantially transverse to said foot piece, and spring means carried by said strut bars and operatively connected to said foot piece to resiliently control movement of said foot piece relative to said strut bars and movement of the two parts of said foot piece relative to each other, said spring means comprising a pair of springs carried by said strut bars and means connecting said springs to said foot piece, the connecting means for one of said springs including a roller in the rearward end of said foot piece and a cable passing under said roller and connected to the toe part of said foot piece near the bottom surface of the latter.

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REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,152,402	Davies	Mar. 28, 1939

FOREIGN PATENTS

Number	Country	Date
114,385	Great Britain	Apr. 4, 1918
316,659	Germany	Dec. 1, 1919