

March 9, 1965

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WEIGHT RESPONSIVE KNEE LOCK FOR ARTIFICIAL LEG

Filed July 20, 1961

4 Sheets-Sheet 1

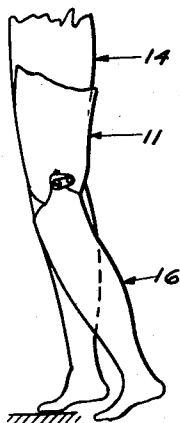


Fig. 1

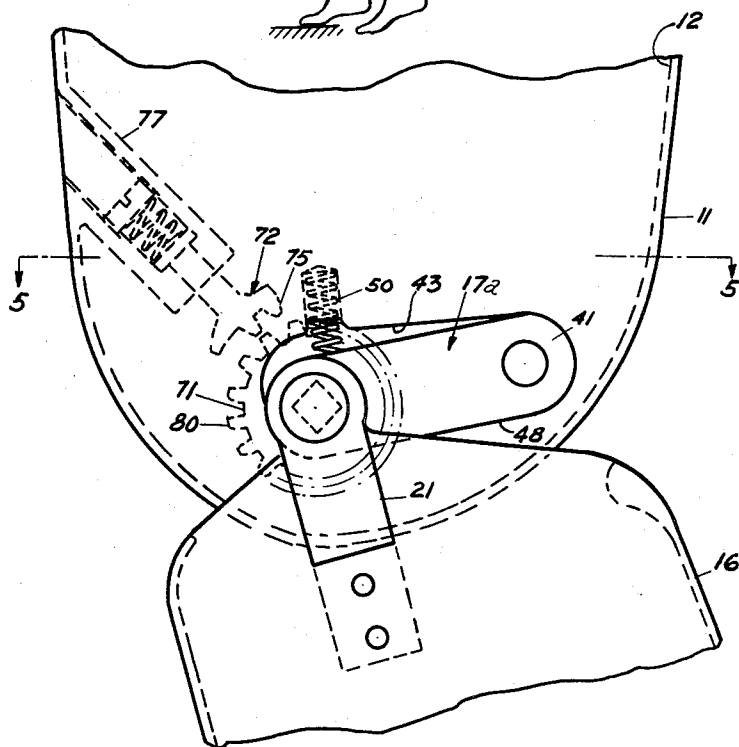


Fig. 2

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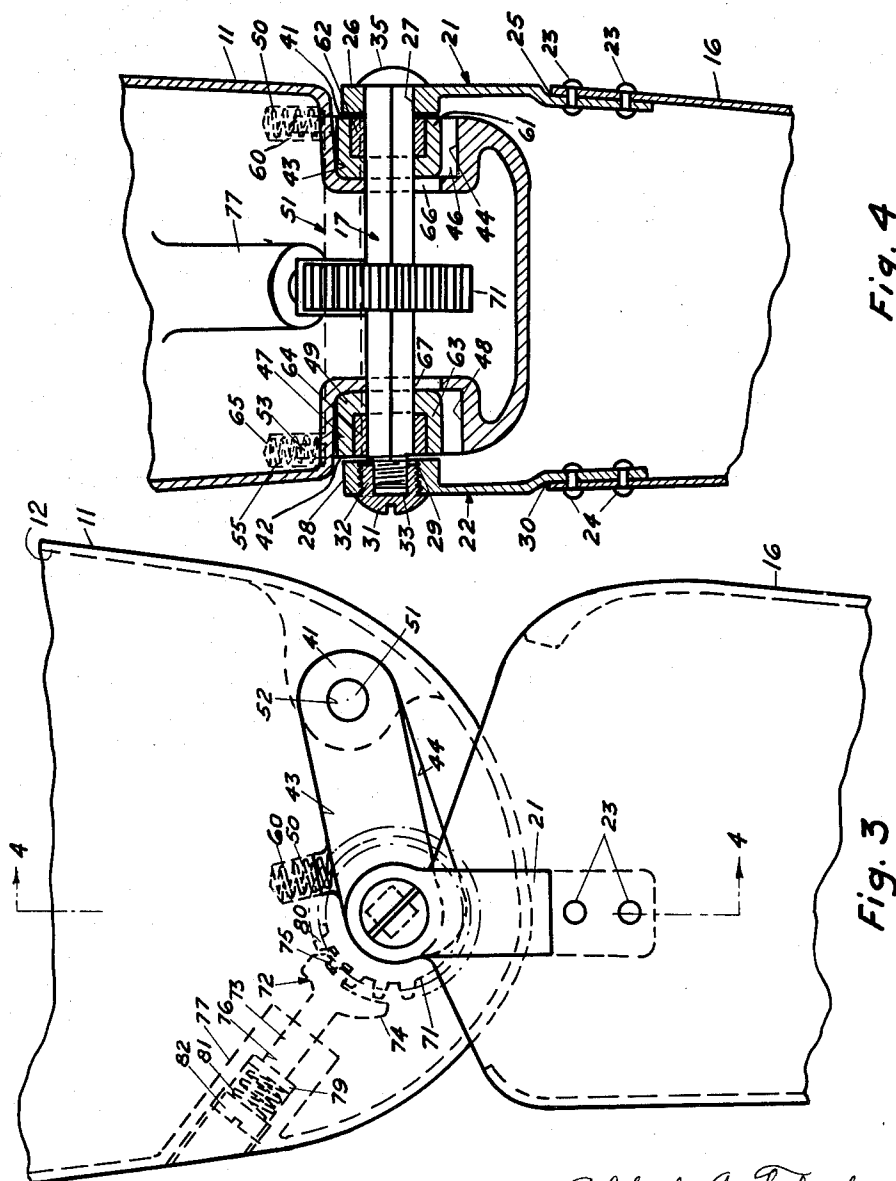
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4 Sheets-Sheet 2



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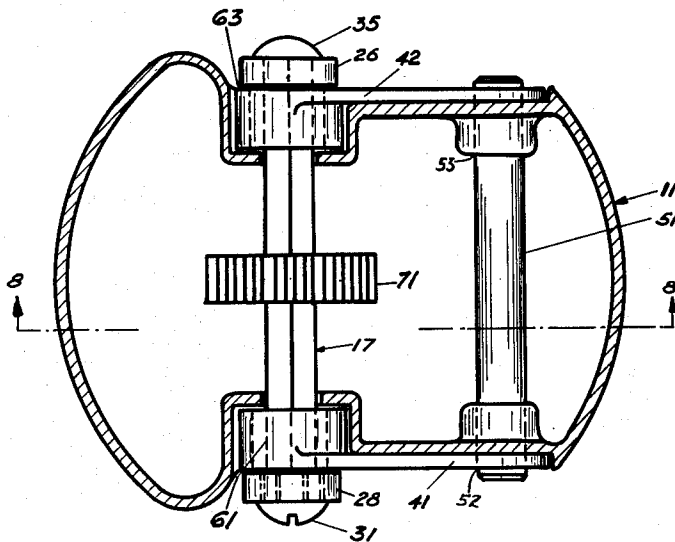


Fig. 5

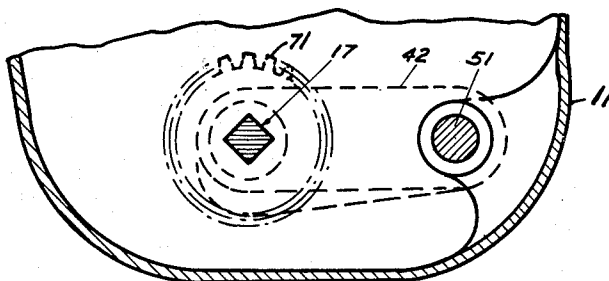


Fig. 6

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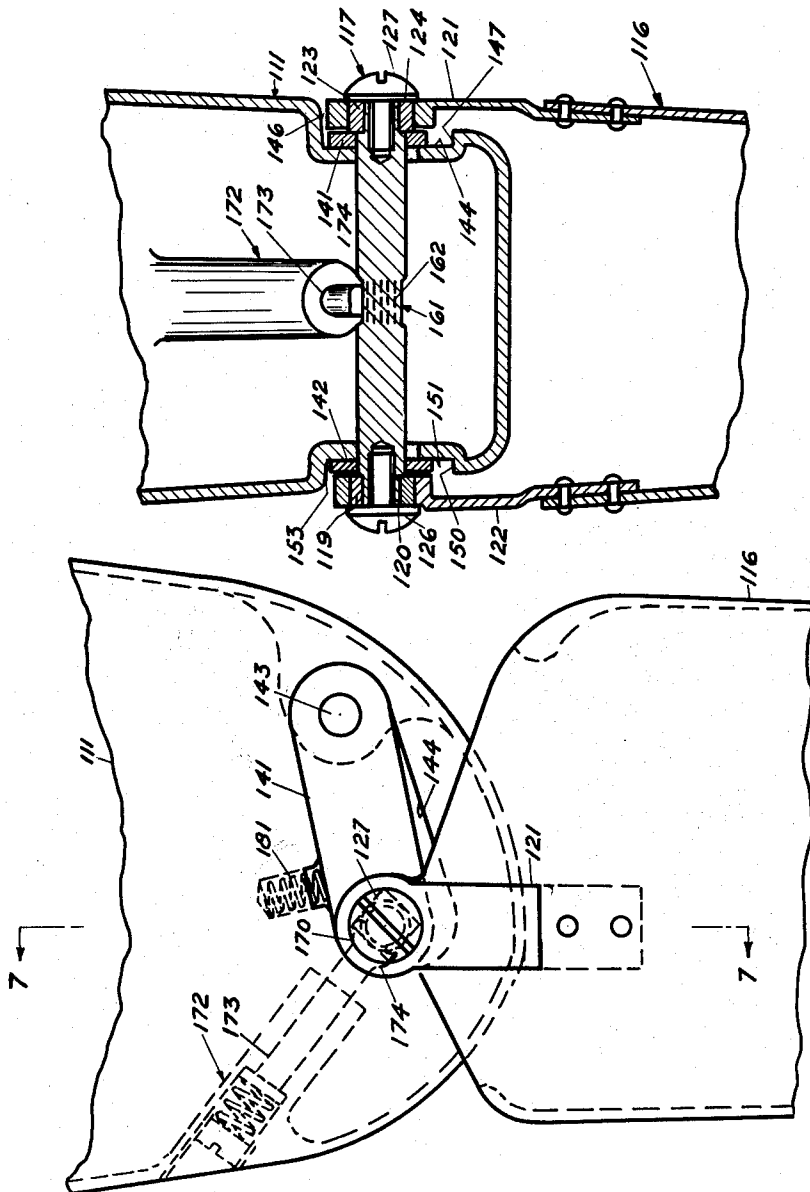
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WEIGHT RESPONSIVE KNEE LOCK FOR ARTIFICIAL LEG

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4 Sheets-Sheet 4



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3,172,127

WEIGHT RESPONSIVE KNEE LOCK FOR ARTIFICIAL LEG

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2 Claims. (Cl. 3—27)

This invention relates to artificial limbs and more particularly to an artificial leg.

Many devices have been made in the past to be used as a substitute for an amputated leg. Some devices while reasonably satisfactory have been so complex from a mechanical standpoint that they have been almost useless insofar as the user is concerned. This has been particularly true when repairs were necessary. Many artificial limbs have been awkward and cumbersome to use. Others have not been positive in their action and the user has frequently fallen. In still others the inventor has not tried to simulate actual body movements. This, of course, has resulted in a strain on the user.

Accordingly, an object of this invention is to provide an artificial leg that responds to use in a manner simulating a normal leg.

Another object of the invention is the provision in an artificial leg of a novel mechanism that positively prevents movement of one part relative to another after the user has applied weight to the leg.

Another object of the invention is a provision of an artificial leg which is positive in its action, which is simple to construct, and which is relatively inexpensive to produce.

Other objects and advantages of the invention will become more apparent upon reference to the accompanying drawings, in which:

FIGURE 1 is an elevational view of an artificial leg embodying the present invention attached to a user's leg.

FIGURE 2 is an enlarged vertical, sectional view showing details of construction.

FIGURE 3 is a view similar to FIGURE 2 with the parts in a different position.

FIGURE 4 is a sectional view taken substantially along the line 4—4 of FIGURE 3.

FIGURE 5 is a sectional view taken substantially along the line 5—5 of FIGURE 2.

FIGURE 6 is a vertical, side view of a modified form of the invention.

FIGURE 7 is a sectional view taken along the line 7—7 of FIGURE 6.

FIGURE 8 is a sectional view taken substantially along the line 8—8 of FIGURE 5.

Referring now to the drawings, the invention is shown embodied in an artificial leg of the type adapted to be attached to the thigh of a user or wearer. For purposes of illustration, the artificial leg herein described is for use as a left leg. It is to be understood, however, that the principle illustrated herein can be adapted for either leg. In this embodiment the artificial leg comprises an upper leg portion 11 having a recess 12 for the stump of the thigh 14 of the wearer, and a lower leg portion 16 of conventional construction. The upper leg portion 11 and the lower leg portion 16 are interconnected so that when the wearer raises or lifts the upper portion 11, the latter is moved bodily relative to the lower leg portion 16 and the lower leg portion 16 is free to swing about the upper portion 11; and when the wearer places his weight on his leg, the upper leg portion 11 and the lower leg portion 16 are positively locked in the position they were in when the weight was applied.

As shown, the upper leg portion 11 and the lower leg portion 16 are interconnected by a movable floating hinge pin mechanism 17a mounted in such a manner that the lower leg portion 16 can be moved between a position in

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which it is in alignment with the upper leg portion 11 and a position in which the lower leg portion 16 is at an angle to the upper leg portion 11.

The hinge pin or spindle 17 proper is supported by straps 21 and 22 rigid with the lower leg portion 16. The strap 21 is secured to the lower leg portion 16 as by rivets 23 and extends above the lower leg portion. As shown, the strap 21 is deformed to fill in a recess 25 on the upper end of the lower leg portion for receiving the strap. At its upper end the strap 21 is formed with an enlarged portion 26 having an opening 27 for snugly receiving the hinge pin or spindle 17. Preferably the spindle is of a square cross section so that the spindle 17 and the lower leg 16 may be held in fixed relation. The strap 22 is secured to the lower leg portion 16 as by rivets 24 and extends above the lower leg portion 16 on the side opposite to the strap 21. In this instance the strap 22 is deformed, as shown, to be received in the recess 30 formed at the upper end of the lower leg portion for receiving the strap. At its upper end the strap 22 is formed with an enlarged portion 28 having a threaded opening 29 for receiving a screw 31. The end of the screw 31 is formed with a threaded recess 32 shaped to receive the threaded end 33 of the spindle 17. The pin 17 is formed with a head 35 at its opposite end. This construction also insures that the spindle 17 and the lower leg portion 16 are in fixed relation. It is to be seen that this construction also permits easy assembly and disassembly of the components.

The spindle 17 is movable between opposed positions. One position is determined when the wearer applies weight to his leg and the other position is determined when the wearer removes his weight from and lifts the upper leg portion 11. While any suitable means may be used for defining the limiting position of the spindle, herein they are established by a link 41 and sidewalls 43 and 44 of a recess 46 (see FIGURE 4) and link 42 and sidewalls 47 and 48 of a recess 49. The links 41 and 42 are on opposite sides of the upper leg portion 11 and are pivotally interconnected with the spindle 17. The link 41 as shown in FIGURES 4 and 5, is pivotally mounted on a shaft 51 as by forming the link with an opening 52 that fits over the end of the shaft 51. The outer edge of the shaft may be peened over to secure the link in position. If desired, headed screws may be threaded into the end of the shaft to secure the parts in position as in the manner in which the screws 31 and 35 are threaded into the spindle 17. In a similar manner the link 42 is formed with an opening 53 shaped to receive the other end of the shaft 51. The end of the shaft 51 may be peened over to secure the link 42 in position. The shaft 51 is mounted in the upper leg portion 11 so that it extends through the upper leg portion.

The recesses 46 and 49 are formed in the upper leg portion and are of size and shape to receive the links 41 and 42 respectively and permit limited movement of the links about the shaft 51. In this instance engagement of the link 41 with the sidewall 43 of the recess 46 and engagement of the link 42 with the sidewall 47 of the recess 49 limits movement of the spindle 17 in one direction to define its upper or locked position, and engagement of the link 41 with the sidewall 44 of the recess 46 and engagement of the link 42 with the sidewall 48 of the recess 49 limits the movement of the spindle 17 in the other direction to define its bottom or unlocked position.

The link 41 is formed with an enlarged end 61 having a recess for a bearing 62. The latter is mounted on the spindle 17. In a similar construction the link 42 is formed with an enlarged end 63 having a recess for a bearing 64. The latter is also mounted on the spindle 17. This construction permits rotational movement of

spindle 17 relative to the links 41 and 42 and the upper leg 11.

Elongated slots 66 and 67 are formed in the bottom of the recesses 46 and 49 respectively to permit vertical movement of the spindle 17. The slots 66 and 67 extend generally in a vertical direction and are of size to permit movement of the spindle 17 between its opposed positions.

With this construction it is seen that the spindle 17 is free to float or move up and down with limited movement that is to swing about the shaft 51 as a pivot point and that the sidewalls of the recess in effect define abutments or shoulders that limit movement of the spindle 17.

In this embodiment the links 41 and 42 are normally urged to their lower positions as is the lower leg 16 as by springs 50 and 55. The spring 50 is disposed in a recess 60 formed in the upper portion 11 so that the spring is disposed between the top of the link 41 and the bottom of the recess. The spring is biased to urge the link 41 downwards. The spring 55 is disposed in a recess 65 in the upper portion 11 so that the spring 55 is disposed between the link 42 and the bottom of the recess. The spring 55 is biased to urge the link 42 downwardly.

Means are provided for positively locking the upper leg portion 11 and the lower leg portion 16 in fixed relation when the wearer of the artificial leg applies weight to his leg. In this embodiment this is effected by a gear or toothed segment 71 and a detent mechanism 72 mounted to be enclosed by the upper and lower leg portions while at the same time permitting normal movement of the upper and lower leg portions as described. The gear segment 71 is mounted on the spindle 17 at a position intermediate the ends of spindle 17 so as to be enclosed in the leg portion 11. The gear is fixedly mounted on the spindle 17 and is arranged so that it moves or rotates in unison with the lower leg portion 16.

The detent mechanism 72 is mounted on the upper leg portion 11 so as to be enclosed within the leg portion 11 as shown and includes a plunger 73 having a head 74 formed with teeth 75 shaped to engage teeth 80 on the gear segment 71. The plunger 73 is received in an opening 76 in a boss 77 mounted in the upper portion 11 and projecting downwardly toward the gear segment 71. The outer end of the opening 76 is enlarged to receive a head 79 of the plunger 73. A spring 81 is disposed between the head 79 of the plunger and a threaded member 82 received in the threaded outer end of the opening 76. The pressure exerted on the plunger 73 can be adjusted by varying the tension on the spring. The travel of the plunger is limited to the length of a tooth on the gear segment 71 as shown in FIGURES 2 and 3 which is determined by the length of the pivoting action of the links 41 and 42 between their upper and lower portions.

As can be seen, the detent and gear mechanism are in effect disposed in a chamber formed in the upper leg portion so as to be wholly enclosed. This is advantageous in that the user's clothes do not become entangled with the teeth mechanisms of the leg portions 11 and 16.

The operation of the artificial limb is readily apparent from the foregoing description, but is briefly summarized hereinafter.

The upper portion 11 of the leg is attached to the stump of the wearer's leg in a conventional manner. The user then stands and rests his weight on both legs. The position of the parts for this condition is shown in FIGURE 3. Therein it will be observed that the upper leg portion 11 is in alignment with the lower leg portion 16 and the teeth 75 on the plunger 73 are engaging the teeth 80 on the gear 71 to hold the upper leg portion and the lower leg portion in fixed relation. The link 41 is engaging the sidewall 43, and the link 42 is engaging the sidewall 47. The spindle 17 is in its upper position. The springs 50 and 55 are compressed. If the user wants to take a step forward, he removes his weight

from and raises the upper leg portion 11. This causes the parts to assume the position shown in FIGURE 2. Therein it will be observed that the upper leg portion 11 has been bodily moved relative to the lower portion 16 a distance determined by engagement of the link 41 with the bottom sidewall 44 and the link 42 with the bottom sidewall 48. This distance of travel is sufficient to permit disengagement of the gear segment 71 from the teeth 75 of the detent mechanism 72. The springs 50 and 55 are biased to help move the parts to this position positively and instantaneously releasing the locking mechanism. The spindle 17 has also been moved to its lower position. In this position of the parts the user is free to move his leg forward as in walking. During this phase of the step, the lower leg portion 16 hangs down at an angle to the axis of the upper leg portion 11. When the user has taken a step, he again puts some weight on his leg. This causes the locking mechanism in the upper leg portion to move bodily downward toward the lower leg portion 16 to the position shown in FIGURE 3. The links 41 and 42 swing about the axis of the shaft 51 and links 41 and 42 engage the tops of the recesses 43 and 47 respectively and the spindle 17 moves to its upper position. The teeth 75 on the detent mechanism engage the teeth 80 on the gear segment 71 and the upper leg portion 11 is in locked relation to the lower leg portion 16. With this construction, it is seen that the teeth 75 swing into and out of engagement with the teeth 80 on the detent. The teeth 75 and 80, as can be seen, are arranged so that the upper leg portion 11 can not move clockwise about the spindle 17.

It is readily apparent that this construction enables a user of an artificial leg to walk in a very nearly normal manner. Also the possibility of falling has been minimized, if not entirely eliminated. This construction is simple in operation yet rugged in use. It is comparatively inexpensive to produce.

FIGURES 6 and 7 show the details of construction of a modified form of my invention. In general the artificial leg comprises an upper leg portion 111, having a recess for the stump of a thigh of the wearer, and a lower leg portion 116. The upper leg portion 111 is interconnected with the lower leg portion 116 through a pin 117 in a manner similar to that described hereinbefore. As shown herein, the pin 117 is supported by straps 121 and 122 mounted on the lower leg portion 116. In this instance the end 119 of the pin 117 is of reduced cross sectional area, preferably square, and shaped to fit a bushing 120 retained in a recess in the strap 122 to effect a rigid connection between the strap 122 and the pin 117. The other end 124 of the pin 117 is also of reduced cross sectional area, preferably square, and shaped to fit in a bushing 123 snugly fitting a recess in the strap 121. Screws 126 and 127 threaded in opposite ends of the pin 117 retain the components in assembled relation. This construction permits the parts to be easily assembled.

Links 141 and 142 respectively are mounted on each side of the upper portion 116 as described hereinbefore. As shown, link 141 has one end mounted on shaft 143 suitably secured to the upper leg portion 111. The opposite end of the link 141 is formed with an opening shaped to receive the pin 117 in such a manner as to assure a good fit and at the same time permit limited rotational movement. As shown, the link 141 is received in a recess 144 formed on the side of the upper leg portion 111. The upper wall 146 of the recess 144 limits upward movement of the link 141 while the wall 147 limits downward movement of the link.

The link 142 has one end mounted on the pin 143 (not shown) which is suitably secured on the upper leg portion 111. The opposite end of the link 142 is formed with an opening shaped to receive the pin 117 in such a manner as to assure a good bearing tight fit. As shown, the link 142 is received in a recess 151 formed in the opposite side of the upper portion 111 from the recess

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144. An upper wall 153 limits upward movement of the link 142 while a lower wall 150 limits downward movement of the link 142.

In this embodiment the gear segment 161 is formed by cutting the teeth 162 directly on the spindle 117 at an intermediate portion. The detent mechanism 172 is similar to the construction previously described and includes a plunger 173 having a head 174 formed with teeth shaped to engage the teeth 162 on the pin 117.

A spring 181 engages the link 141 to normally urge the latter to its lower position. Another spring, not shown, urges the link 142 to its lower position. These springs are mounted in the same manner as also described hereinbefore.

This construction assures the wearer of an artificial leg that requires a minimum of maintenance, yet a leg which is easy to repair in the event maintenance is necessary. If the gear segment is formed from plastic materials, a virtually noiseless leg results. This leg has a minimum of parts and is easy to construct and reacts in a manner simulating a normal leg.

While I have shown the invention as applied to a leg, it is to be understood that this same principle may be used in other fields.

I claim:

1. In an artificial leg the combination of an upper portion adapted to be attached to the thigh of a wearer and having elongated slots extending lengthwise of said upper leg portion, a lower leg portion having ears at spaced positions and arranged to be adjacent said elongated slots, a spindle extending through said slots and fixedly secured at its ends with said ears, said spindle being free to move bodily lengthwise of said slots between opposed positions in response to application of the wearer's weight on the leg and lifting of the upper portion of the leg, spaced means on each side of said upper portion for limiting the movement of said spindle between said opposed positions, a gear segment on said spindle and bodily movable therewith, said gear segment being wholly disposed within said upper leg portion, detent means disposed wholly within said upper leg portion, and spring-biased means disposed within said upper leg portion for mounting said

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detent means in said upper leg portion to be engageable with said gear segment when said spindle is in one position and disengaged from said gear segment when the spindle is in its other position.

2. In an artificial leg the combination of an upper leg portion adapted to be attached to the thigh of a wearer and having a recess on each side, each recess having spaced walls defining spaced opposed abutments and a wall having an elongated slot, said upper leg having a chamber, a lower leg portion having spaced ears arranged respectively to be adjacent the recesses, a spindle extending through each of said slots and chamber and fixedly secured at its ends with said ears, said spindle being free to move bodily lengthwise of said slots and chamber between opposed positions in response to application of wearer's weight on his leg and lifting of the upper portion of the leg, link means on each side of said upper leg portion disposed in each of said recesses and movable between said abutments, means on each side of said upper leg portion for pivotally mounting one end of each of said links on said upper portion and means on each side of said upper leg portion for pivotally interconnecting the other ends of said links with said spindle, a gear segment within said chamber in the upper leg portion mounted on said spindle and bodily movable therewith, detent means within said chamber in the upper leg portion, and means for mounting said detent means in said chamber in the upper leg portion to be engageable with said gear segment when said spindle is in one position and disengaged from said gear segment when the spindle is in its other position.

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