July 15, 1941. L. C. SANSBURY 2,249,365

ARTIFICIAL LEG

Filed March 19, 1940 2 Sheets-Sheet 1

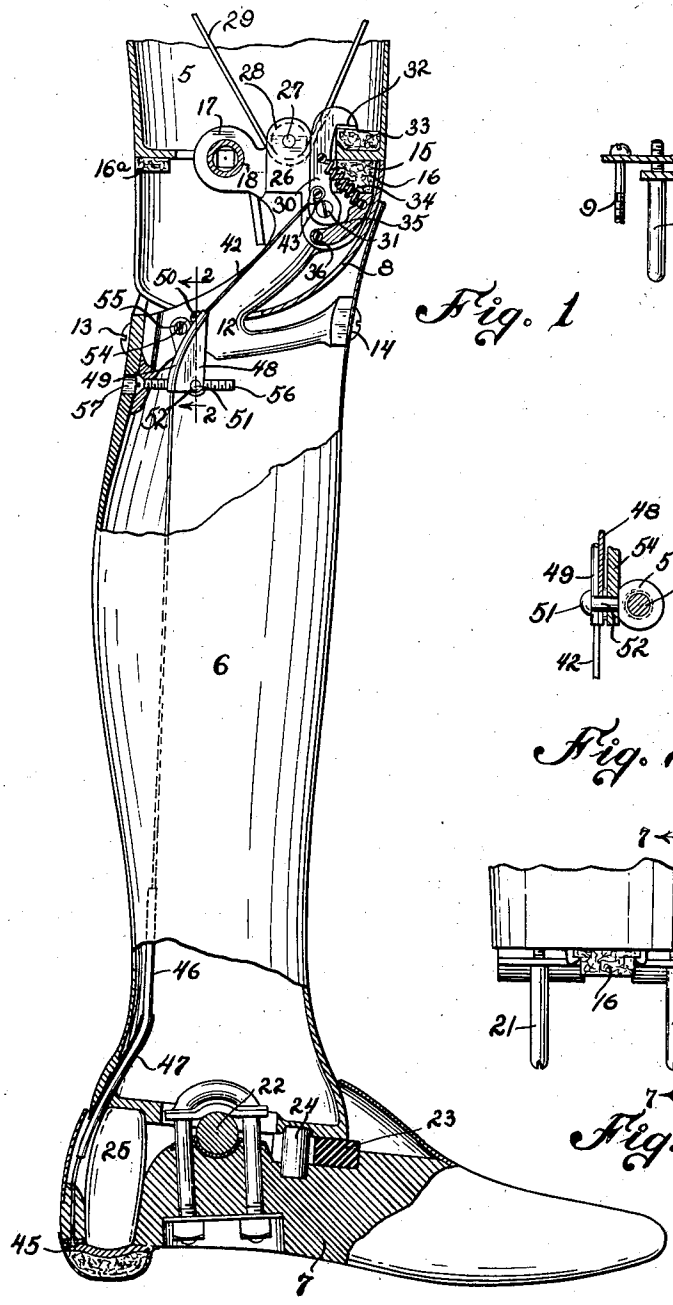


Fig. 1

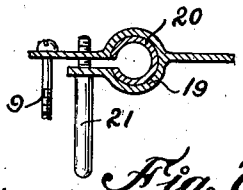


Fig. 7

Fig. 2

Fig. 8

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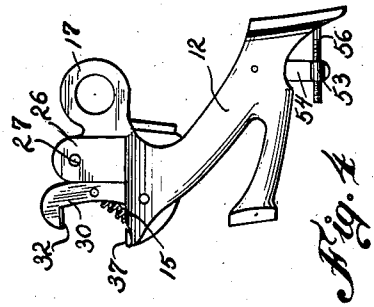


Fig. 4

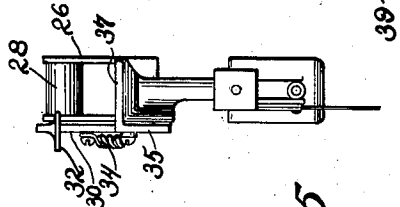


Fig. 5

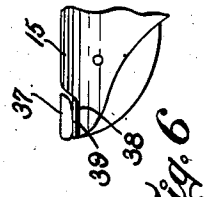


Fig. 6

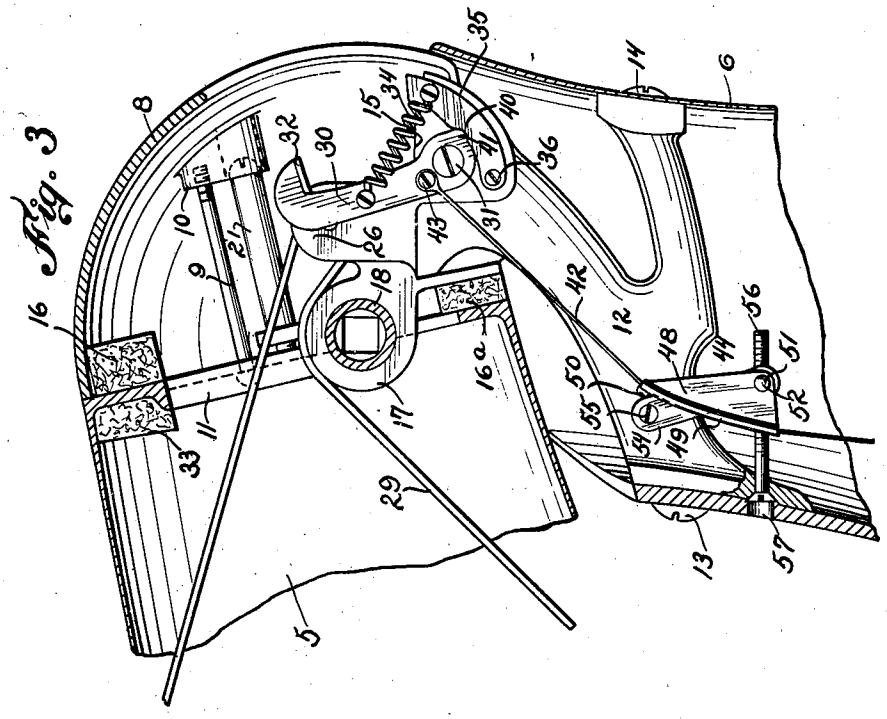


Fig. 3

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2,249,365

UNITED STATES PATENT OFFICE

2,249,365

ARTIFICIAL LEG

Lemuel C. Sansbury, Arlington, Va., assignor, by mesne assignments, to Metal Limb Manufacturers, Inc., Washington, D. C., a corporation of Delaware

Application March 19, 1940, Serial No. 324,859

21 Claims. (Cl. 3—2)

This invention relates to artificial legs, and it has for its object to provide an improved article of this nature by means of which the comfort and safety of the wearer will be improved, and a leg will be provided which will more nearly simulate the action of a natural limb than has heretofore been possible.

One of the primary objects of the invention is to provide means for automatically locking the thigh and calf portions of the leg rigidly together when they assume positions of longitudinal alignment with respect to each other, and for releasing said locking means when pressure is brought to bear upon the ball or toe portion of the foot in the act of taking a step. I am aware of the fact that the prior art discloses that locks of this general nature were proposed more than half a century ago, but as this description proceeds it will be seen that my proposed arrangement of parts secures the desired result in an extremely economical, facile, and efficient way, and accomplishes results not accomplished by any of the previously known structures.

In the accompanying drawings:

Fig. 1 is a view partly in side elevation, and partly in vertical section of an artificial leg constructed in accordance with the invention.

Fig. 2 is a fragmentary sectional view upon line 2—2 of Fig. 1.

Fig. 3 is an enlarged vertical sectional view through the knee portion of the leg, with the locking mechanism in elevation.

Fig. 4 is a side elevation of the locking mechanism and the knee stop bracket looking from the side opposite to that shown in Fig. 3.

Fig. 5 is a front elevation of the knee stop bracket and locking mechanism.

Fig. 6 is a fragmentary magnified side view of the upper forward portion of the knee stop bracket.

Fig. 7 is a side view of one of the friction bearings of the thigh portion of the leg, and,

Fig. 8 is a front elevation of a part of the thigh portion with the knee cap removed.

Like numerals designate corresponding parts throughout the several figures of the drawings.

Referring to the drawings: 5, designates the thigh portion, 6, the calf portion and 7, the foot portion of an artificial leg.

The thigh portion carries as a constituent part thereof a knee cap 8, said knee cap being held in place by bolts 9, which engage lugs 10, of the knee cap, said bolts passing through flange 11, of the thigh portion.

A knee stop bracket 12, spans the calf portion of the leg, and is secured thereto by the screws 13 and 14. This knee stop bracket is provided at its upper front end with a flat face 15, which constitutes an abutment that is engaged by a front knee stop, or bumper 16, to limit the forward movement of the thigh portion when the thigh and calf are brought into vertical alignment with each other. The rearward movement of the thigh portion is limited by a back stop 16a. The stop 16, is secured to the flange 11.

Extension 17, of the bracket 12, is carried by a hollow bolt 18, and turns with said bolt. This bolt, in turn, is mounted in bearings 19, having self-lubricating, non-metallic linings 20, said bearings being carried by the thigh portion, and being capable of adjustment to increase or decrease the friction imposed by them upon the bolt by means of adjusting screws 21 (see Figs. 7 and 8).

The foot is pivotally mounted to have limited rocking movement, with respect to the calf portion, upon pivot 22. Resilient blocks, such as rubber, indicated at 23, 24, and 25, hold the foot in the position illustrated in Fig. 1, except when the weight of the wearer is brought to bear upon said foot.

The bracket 12, also carries bearing extensions 26, for the support of the shaft 27, of an inside control roller 28. A strap 29, passes over this control roller, and includes elastic portions, not shown, in its length, the upper ends of the strap being secured to a belt worn by the wearer, and the function of this strap being to constantly tend to throw the calf portion forwardly with respect to the thigh portion, and to thereby bring the parts into the position illustrated in Fig. 1.

The parts so far described are those constituting one well-known and very popular form of metal leg already on the market. In the early days of artificial leg manufacture, the builders of legs sought primarily to provide something upon which a man could stand and walk, and little attention was paid to appearance or to relieving the wearer from the embarrassment caused by the use of a leg which was awkward in its movement, or squeaky or noisy in operation.

With the gradual refinement of the art, and with the advent of modern metallic alloys combining great strength with very light weight, it has been possible in late years to reduce the size of artificial legs to something approaching the natural size of the leg. However, this reduction

in size has correspondingly decreased the space inside the leg, in which to mount such mechanical elements as are necessary in the function of the leg. Further, this decreased space, especially in conjunction with legs in which the calf portions are composed of completely tubular members, renders the internal parts very difficult of access, either for initial assembly or for adjustment of the parts. It will be observed by referring to Fig. 1, that the pivot constituted by the bolt 18, and associated parts, lies materially nearer the rear side of the leg than the forward side thereof, and this results in the major portion of the weight of the wearer being disposed in advance of the pivot when the wearer is in a standing position. This reduces the likelihood of the knee stop 16 moving away from the abutment 15 under slight swaying of the wearer beyond what would be the case if the pivot 18 were equi-distant between the front and rear of the knee.

In meeting the problems presented by the constricted space, and in taking advantage of the position of the pivot 18, I provide a lock and appurtenant elements all mounted upon, and bodily movable with, the bracket 12, so that by merely removing the screws the entire locking mechanism may be lifted out of the calf portion. This greatly facilitates initial assembly in manufacture or subsequent adjustment of parts. Further, I so locate and form the latch of the locking mechanism, that while it is pivotally mounted upon, and carried by a calf carried member, to wit, the bracket 12, it is of such length as to extend up through the knee cap and have hooking engagement over a keeper mounted above the knee stop 16. Thus, the locking action is applied at the extreme front portion of the knee, or at that point where it will be most effective in taking advantage of the offset mounting of pivot 18. In accomplishing this result, I pivot a latch 30, upon the side face of bracket 12 by means of a screw 31. This latch carries a hook-like upper end 32, laterally extended to give it increased bearing upon a keeper 33, that is secured within the channel-like flange 11. This keeper and the abutment 16 are preferably formed of an extremely hard and tough felt. This material is wear-resistant to a marked degree, and since it is non-metallic, it provides for the noiseless operation of the parts so essential in a device of this character. One end of a tension spring 34, is connected to the latch 30, and the other end of said spring is connected to a trigger 35, that is pivoted at 36, upon the side face of bracket 12. This trigger has its terminal upper end laterally extended to provide an arm 37 (see Figs. 4, 5 and 6). As is best illustrated in Fig. 6, the terminal upper end of the bracket is recessed as indicated at 38, for the reception of arm 37, and is lined with a cushioning pad 39, of some non-metallic sound-deadening, wear-resistant material such as horsehide. The trigger 35, is provided with a detent recess 40, and the tail of the latch is provided with a tongue 41, adapted to coact with said recess.

A very strong flexible metallic cable 42, is connected to the latch at 43. This cable extends downwardly through an adjusting mechanism indicated in a general way at 44, and its lower end is secured at 45, to the heel of the foot portion. A portion of this cable is rubber covered as indicated at 46, and this rubber covered portion passes through a metal tube, at 47. This structure protects the cable against wear, and also renders its operation noiseless. The adjusting mechanism for the cable includes an adjustable throw eccentric comprising a web or plate 48, having a curved tubular edge member 49, through which the cable passes.

A binding screw 50, Fig. 3, binds the cable against movement through the tubular portion 49. The lower forward corner of the web 45, is pivotally mounted (see Figs. 2 and 5) at 51, upon a headed stud 52. This stud is carried by a nut 53. The stud 52, passes through the lower end of a swinging link 54, the upper end of said link being pivoted at 55 to the bracket 12. The nut 53 has threaded engagement with an adjusting screw 56, the head of said screw being accessible from the exterior of the calf through an opening 57, drilled in the rear wall of said calf.

By loosening the screw 50, and adjusting the rocking eccentric 48, laterally, just the right tension may be imposed upon cable 42, after which the screw 50, may be tightened. After that a downward pull upon the cable as the wearer steps upon the toe or ball portion of the foot results in rocking the eccentric 48, upon the pivot, to impart a rearward pull upon latch 30. Since the head of the screw 56 is accessible from the exterior of the leg, it follows that the adjustment of the tension of the cable and its action upon the latch 32 may be effected while the leg is being worn. This is highly important, since it renders it possible to adjust the action of the latch in accordance with the peculiarities of the wearer with respect to weight, balance, etc. In other words, the wearer may shift his position and vary the tipping of the foot and indicate to the person who is making the adjustment just the right point to which the adjusting screw is to be set. It is clear that this could not be done with any structure in which it was necessary to remove the leg from the wearer in order to effect the adjustment.

Not only is the head of screw 56 accessible from the exterior of the leg, but the binding screw 50 may also be reached by inserting a screw-driver through the top of the calf portion (see Fig. 3). Thus after the web or plate 48 has been bodily adjusted across the calf to get the proper tension upon the cable with the screw 50 loosened, this screw 50 may be tightened with the plate 48 in just the right position to get the most effective pull. This would be when the lower edge of plate 48 was substantially parallel with the screw 56.

The operation of the device follows:

With the parts in the position illustrated, in Fig. 3, the latch 30, is retracted against the tension of spring 34, and it is held in this retracted position by the engagement of the detent recess of the trigger 35, with the tongue 41, of the latch. Not only does the spring 34, hold the detent or trigger 35, into latch-retracting position, but it also tends to throw the latch forwardly. In addition, it elevates the arm 37, which is moved by it, such a distance above the level of the abutment 15, that when the knee stop 16, strikes said arm in coming to its seat upon said abutment, it moves said arm downwardly until it rests upon the cushion 39.

This action takes place only after the calf portion has swung forward in the act of taking a step until it is brought into substantial alignment as illustrated in Fig. 1. By this time the keeper 33, has moved to such position that when the hook-like upper end of the latch moves forwardly, it may engage over said keeper and lock

upon which said member is mounted for rocking movement.

9. A structure as recited in claim 2 wherein the connection between the foot and latch comprises a flexible cable, a rocking member with which said cable is engaged, and a support upon which said member is mounted for rocking movement, and means for adjusting said support laterally with respect to the calf portion.

10. A structure of the character described comprising a calf portion, a thigh portion and a foot portion, a latch constituting a locking connection between the thigh and calf portions, a cable connecting the heel of the foot portion to said latch, a cam to which said cable is connected and through which cam said cable is adjustable, a support upon which the cam is pivoted for rocking movement, and means accessible from the exterior of the calf portion for adjusting said support and cam bodily across the calf portion, to thereby effect adjustment of said cable from the exterior of the leg while the leg is being worn.

11. A structure as recited in claim 10 wherein said adjusting means comprises a screw the head of which is engageable from the exterior of the calf portion, whereby the adjustment may be effected while the leg is being worn and to suit the weight and balance of individual wearers.

12. In artificial legs of the character comprising a thigh carried knee stop and a calf carried abutment for engagement by said knee stop, a locking mechanism comprising a latch pivoted at its lower end in the calf of the leg and of a length such that its upper end projects into the thigh when the calf and thigh are aligned, a keeper within the thigh over which the upper end of said latch is adapted to hook, a pivoted detent for the latch, a spring connecting the detent and latch and tending to draw them together and interengaging faces upon the latch and detent shaped to hold the latch in retracted position under the tension of said spring, and means carried by the detent and disposed in the path of movement of the thigh carried knee stop for moving the detent against the action of said spring under the pressure of the knee stop to release the latch and permit the spring to throw the upper end of the latch into engagement with said keeper.

13. A structure as recited in claim 12, in combination with a foot portion pivoted for rocking movement with respect to the calf, and a cable connecting the foot portion with the latch at a point between the pivot of said latch and its keeper engaging end.

14. In an artificial leg construction, the combination with relatively thin metallic shells shaped to constitute thigh and calf portions, means for pivotally uniting said portions comprising a rigid metallic knee check bracket spanning the calf portion and being secured to the front and rear sides thereof, said bracket carrying bearing members for the thigh portion and a knee stop abutment, a front knee stop of non-metallic material within the thigh portion in position to contact said abutment, a latch having a hook-like upper end pivotally mounted at its lower end upon a side face of the knee check bracket, a detent lever also pivoted to the knee check bracket adjacent the latch, interengaging cam faces upon the heel of the latch and a side of the detent lever, a spring connecting the detent lever and the latch tending to draw their interengaging cam faces together, said detent lever having a laterally extending arm which lies across the upper face of said knee stop abutment and in the path of movement of the thigh carried knee stop, as and for the purposes set forth.

15. A structure as recited in claim 14, in combination with a foot portion pivoted for rocking movement with respect to the calf portion, and an operating cable connecting the heel of the foot portion with the latch at a point between the pivot and the free end of the said latch.

16. In combination with an artificial leg of the type comprising a thigh portion and a calf portion and wherein the said portions are pivotally united with each other at a point materially nearer the rear than the front of said portions so that the major portion of the weight of the wearer is brought to bear upon the front side of the said portion, a latch for locking said portions into vertical alignment with each other, said lock comprising a member lying adjacent the front of the leg pivoted to one of said portions and of a length to extend vertically into the other of said portions and across the pivot line between said portions, a keeper in the other of said portions shaped to be engaged by said member, a foot portion pivoted for rocking movement upon the calf portion, a cable connected to said foot portion, and means whereby a pull upon said cable under downward movement of the heel of the foot portion releases said lock to permit the thigh and calf portions to move to positions of angularity with respect to each other.

17. In an artificial leg construction, the combination with a thigh portion and a calf portion, a stiffening bracket extending laterally across and forming a brace between and being secured to the front and rear walls of the calf portion, a spring actuated latch projecting from the calf portion up into the thigh portion, and a trigger for holding the latch in retracted position, both the latch and trigger being pivotally mounted upon the bracket for bodily removal therewith from within the calf portion.

18. A leg of the character described comprising a thigh portion and a calf portion, a latch supporting element mounted in one of said portions, a latch mounted upon said support spring actuated, a trigger for said latch, both the trigger and its actuating spring being mounted upon said support, said latch and trigger being bodily removable with said support from said portion, and a trigger actuating member carried by the other of said portions, said support extending transversely across the calf portion and constituting a rigid brace between the front and rear walls of said calf portion.

19. In a lock construction for artificial legs the combination with a locking latch, a cable for actuating said latch from a foot portion, and means disposed in the length of said cable for compounding the pull upon the latch by said foot and for taking up slack in said cable, said means comprising a plate-like member having a short side, a long side, and an arcuate edge, said plate-like member being pivoted adjacent the juncture of its long and short sides and being provided along its arcuate edge with a tubular member through which said cable passes, means for binding said cable against endwise movement through said tubular member and means for bodily adjusting the pivot of the plate-like member transversely across the calf portion of the leg, and from a point outside of

the thigh and calf portions. Thus the leg can not collapse and cause the wearer to fall before he has had time to adjust his balance. When, in taking a step forward with the other leg he brings the weight upon the ball of the foot, the forward portion of the foot, in effect, rises with respect to the calf, and this in turn moves the heel downwardly with respect to the calf, enough to impose such pull upon the cable as to withdraw the latch and restore it to the position illustrated in Fig. 3.

It should be noted that the eccentric or cam **48**, is so shaped that it constitutes, in effect, a bell crank lever, its lower edge representing one arm of said lever, and its vertical wall representing the other arm of said lever, the vertical arm being materially longer than the horizontal arm. Thus, this member **48**, serves not only to change the direction of pull of the upper part, but it also compounds the movement. That is to say, a relatively short pull by the heel upon the lower portion of the cable is converted into a longer pull upon the latch.

By referring to Fig. 1, it will be seen that when the knee stop **16** thrusts the trigger downwardly, it imposes additional tension upon the spring **34**, to tend to draw the latch to locking position. In addition, this movement of the trigger away from the tail of the latch releases the tongue **41** from the recess **40**, and permits the latch to move forwardly as described. It is to be noted that all portions of the device while easily removable for purposes of repair or adjustment, are, in use, completely housed within the leg, so that no portion of the locking mechanism could ever become entangled with the clothing of the wearer.

In the absence of means for locking the thigh and calf into vertical alignment as described, the wearer must hold the leg against rearward breaking by the action of his stump of leg. In other words, he must be constantly on guard to prevent premature rearward breaking of the leg. This not only requires the expenditure of physical energy, but it imposes nerve strain upon the wearer. This tendency of the leg to prematurely break is increased when the wearer is walking downhill.

It is to be understood that the invention is not limited to the precise construction set forth, but that it includes within its purview whatever changes fairly come within either the terms or the spirit of the appended claims.

Having described my invention, what I claim is:

1. In an artificial leg of the type comprising a calf portion, a thigh portion and means for pivotally connecting them together; an abutment carried by the calf portion and located at the upper end of the front side thereof, a knee stop, mounted at the front side of the thigh portion located in position to engage said abutment when the calf and thigh portions reach positions of alignment, a latch pivotally mounted upon the calf portion to swing in a substantially vertical plane toward and from the front side of the calf portion, said latch being of a length to extend upwardly into the thigh portion when the calf and thigh portions are vertically aligned, a keeper carried by the thigh portion adapted to be engaged by the upper end of said latch, resilient means tending to move said latch into engagement with said keeper, a foot pivoted for rocking movement with respect to the calf portion, connections between the foot and latch for retracting the latch against the action of said resilient means, a detent for holding the latch in retracted position, and means operable upon completion of the movement of the thigh and calf portions to positions of alignment for moving the detent to release the latch and permit the resilient means to throw it toward and into locking engagement with the keeper of the thigh portion.

2. In an artificial leg of the type comprising a calf portion, a thigh portion and means for pivotally connecting them together; a latch pivotally mounted upon the calf portion to swing in a substantially vertical plane toward and from the front side of the calf portion, said latch being of a length to extend upwardly into the thigh portion when the calf and thigh portions are vertically aligned, a keeper carried by the thigh portion adapted to be engaged by the upper end of said latch, resilient means tending to move said latch into engagement with said keeper, a foot pivoted for rocking movement with respect to the calf portion, connections between the foot and latch for retracting the latch against the action of said resilient means, a detent for holding the latch in retracted position, and means operable upon completion of the movement of the thigh and calf portions to positions of alignment, for moving the detent to release the latch and permit the resilient means to throw it toward and into locking engagement with the keeper of the thigh portion.

3. A structure as recited in claim 1 wherein the means for moving the detent comprises an arm projecting from said detent across the said abutment of the calf portion and into the path of movement of the knee stop of the thigh portion.

4. A structure as recited in claim 1 wherein the means for moving the detent comprises an arm projecting from said detent across the said abutment of the calf portion and into the path of movement of the knee stop of the thigh portion and wherein said abutment is recessed for the reception of said arm to such degree that when the knee stop comes to rest upon the abutment the top of said arm lies substantially flush with the top of said abutment to aid in supporting the knee stop.

5. A structure as recited in claim 1 wherein the means for moving the detent comprises an arm projecting from said detent across the said abutment of the calf portion and into the path of movement of the knee stop of the thigh portion, said abutment being recessed for the reception of said arm, and a cushion of non-metallic material in said recess beneath said arm, the depth of said recess being such that when the knee stop comes to rest upon said abutment said arm rests upon said cushion.

6. A structure as recited in claim 1 wherein said abutment is recessed for the reception of said arm to such degree as to permit the knee stop to come completely down upon said abutment.

7. A structure as recited in claim 2 wherein the connection between the foot and latch comprises a cable, tension adjusting means for the cable carried by the calf portion, and means for adjusting the tension adjusting means from the exterior of the calf portion.

8. A structure as recited in claim 2 wherein the connection between the foot and latch comprises a flexible cable, a rocking member with which said cable is engaged, and a support

said leg so that adjustment of the action of the cable upon the latch may be effected while the weight of the wearer is upon the foot portion.

20. In a lock construction for artificial legs, the combination with a locking latch, a cable for actuating said latch from a foot portion, means disposed in the length of said cable for compounding the pull upon the latch by said foot and for taking up slack in said cable, said means comprising a plate-like member having a short side, a long side and an arcuate edge, said plate-like member being pivoted adjacent the juncture of its long and short sides and being provided along its arcuate edge with a member through which said cable passes, means accessible from the exterior of the leg for binding said cable against endwise movement through said last-named member and means also accessible from the exterior of the leg for bodily adjusting the pivot of the plate-like member transversely across the calf portion of the leg.

21. An artificial leg comprising a calf portion, a thigh portion pivoted to the calf portion, and a foot portion pivoted to the calf portion, a latch constituting a locking connection between the thigh and calf portions and disposed to hold said portions in longitudinal alignment with each other until said latch is released, a connection between the foot portion and the latch for releasing the latch under movement of the foot portion said connection comprising a cable, a member engaging said cable for compounding the degree of movement of the latch with respect to the degree of movement of the foot, said member serving when moved bodily laterally of the cable to take up slack therein and an adjusting element accessible and operable from the exterior of the calf portion for imparting such bodily lateral movement to said member to thereby adjust the cable tension while the leg is being worn.

LEMUEL C. SANSBURY.