Feb. 16, 1960 J. CHIASSON 2,924,828

ARTIFICIAL BODY MEMBER

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Fig. 1.

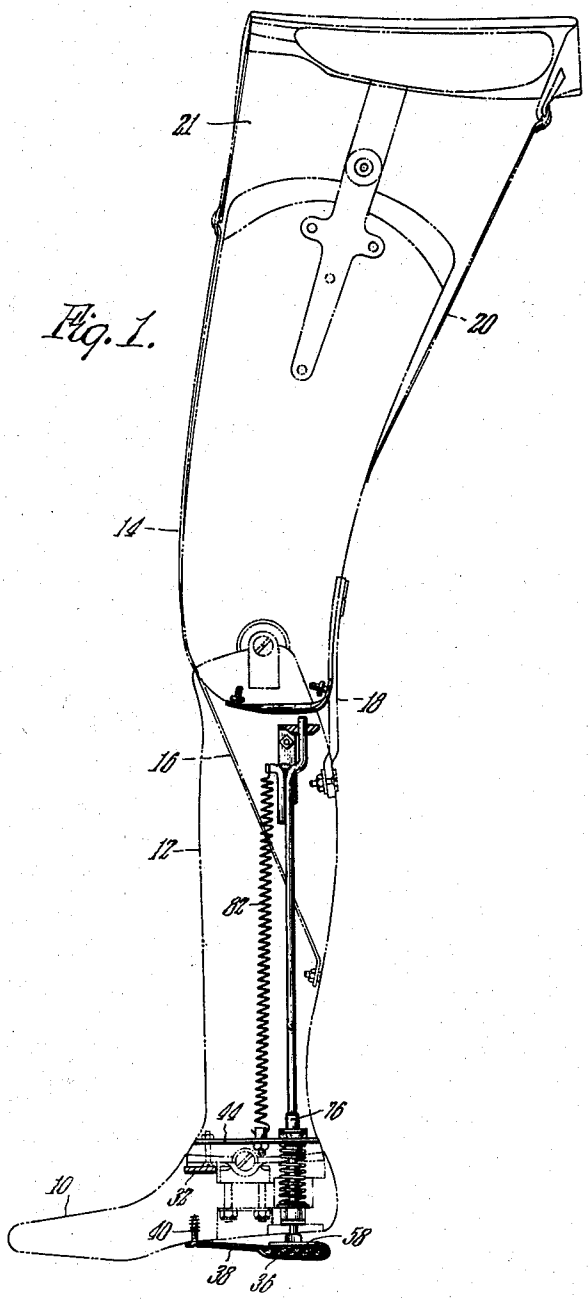


Fig. 3.

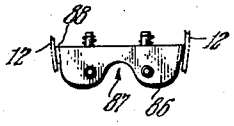
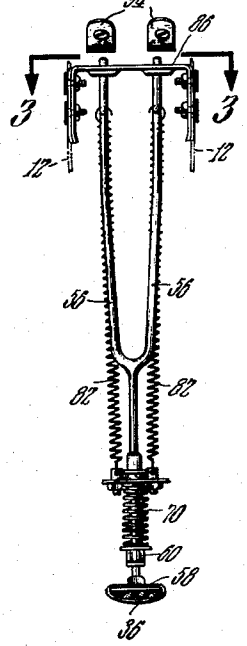


Fig. 2.



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Fig. 4.

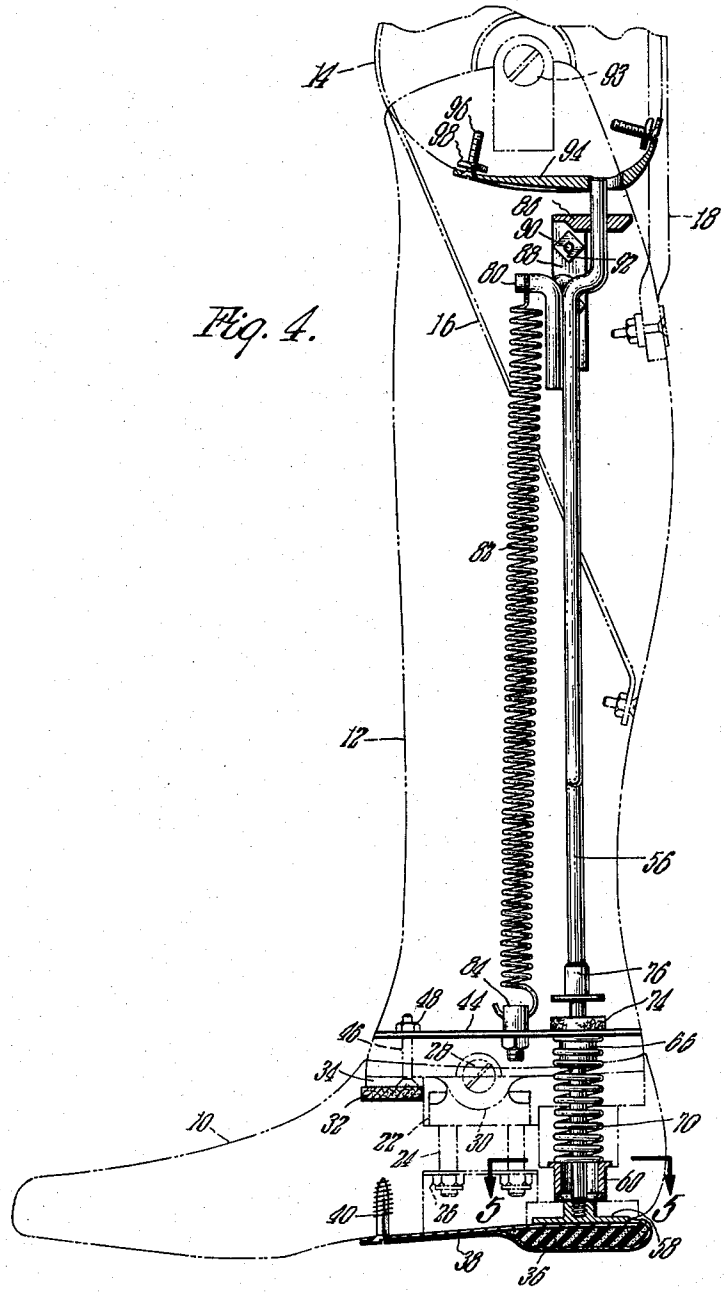
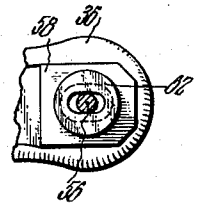


Fig. 5.



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United States Patent Office 2,924,828
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2,924,828

ARTIFICIAL BODY MEMBER

John Chiasson, Holyoke, Mass.

Application January 21, 1958, Serial No. 710,300

5 Claims. (Cl. 3—27)

My invention relates to new and useful improvements in structural refinements in an orthopedic appliance or artificial body member and is directed more specifically to an improved construction of an artificial leg for amputees which will readily and unobstrusively permit the flexing of the device at the knee and ankle joints so that, when walking therewith, the amputee will not be and will not appear to be stiff legged and which will respond to simulate the bending of the knee and ankle without manual effort when the amputee assumes the sitting position.

The invention resides in the particular arrangement, construction and relationship of the various elements of the orthopedic appliance as disclosed in the accompanying description in which the following objects of the invention will be apparent.

As is well known, persons using artificial legs frequently complain that they are stiff and nonlifelike and that they are difficult to wear and to walk with due to their unnatural mechanical action.

It will be appreciated that in the stride during walking, the average person bends his knee while his lower leg swings relative thereto about a horizontal pivot. The ankle likewise flexes about a horizontal pivot. These movements have to be compensated for in order to give an artifical leg a lifelike appearance to an observer and a lifelike feeling to a wearer. It is a prime object of this invention to make these flexing movements possible in the artificial leg hereof.

Upon further observation of the various actions which take place when a man walks, it will be appreciated that the foot normally approaches the ground flatly so as to receive and to support the body weight. By means hereof, a leveling-off of the artificial foot as it is swung ahead of the knee to the extreme forward position of the stride is provided whereby a more natural and lifelike action is provided.

More specifically, the invention relates to a knee joint locking means and an ankle joint flexing means. When weight is placed upon an artificial leg as in walking, it is obviously essential that it be rigid from a location above the knee downwardly to the bottom of the foot. It is also desirable, when in the walking position during those intervals when the weight has been taken off the leg, and likewise when sitting down when the same situation applies, that the knee joint of the appliance be permitted to simulate the normal flexing movement of the knee and that the ankle joint thereof likewise be permitted to simulate the normal flexing movement of the ankle. Same is possible since, on these occasions, the weight has been taken off the leg and it is not necessary that the apparatus be rigid.

Another object of this invention is to provide a foot element and an ankle joint mechanism connecting same to a lower leg element whereby the foot element may pivot within limits to simulate to a degree the normal flexing of an ankle joint.

Artificial limbs of prior art manufacture have usually

been made to provide rigidity at all times, though some have been provided with manually controlled knee and ankle locks. As one of the objects hereof, I provide an operating mechanism for an artificial leg which incorporates a knee joint locking device which acts automatically when weight is taken off the foot so as to permit lifelike flexing.

It is another object hereof to provide a spring operated means which includes pressure responsive elements positioned relative to the heel of the shoe and at approximately the knee joint for displacing components as the posture of the user is changed. Herein, a mechanical and automatically operable latch adjacent the knee joint provides a locking function when the weight of the body is placed on the heel and unlocks when the weight of the body is shifted therefrom (for example to the other foot as when walking).

Other objects of the invention are to provide an artificial body member which will accomplish the foregoing objects and others auxiliary thereto and which is simple in its construction, economical in its manufacture, durable for long and hard usage, and capable of offering the amputee a confident feeling of safety concerning the use thereof.

It is an object of my invention to provide a novel and improved construction which will eliminate the now present objectionable inconveniences and which will operate with a maximum amount of ease and with a minimum degree of effort. That is, I provide structural and operational improvements in devices of the class to which reference has been made, which improvements not only simplify the structure as such, but also provide important distinct advantages in strength, durability, efficiency and the like.

These together with other incidental objects and advantages of my invention which subsequently will become apparent as the description proceeds reside in the details of construction and operation as more fully hereinafter described and claimed and the features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to and forming part of this specification.

To the accomplishment of the foregoing and related ends, said invention intended to be protected by Letters Patent then comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawing setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

In the drawings:

Fig. 1 is a view in side elevation of the operating mechanism of the artificial leg of this invention with the foot and leg elements thereof being shown in dot-dash lines, the operating mechanism being in the unlocked position,

Fig. 2 is a rear elevational view of the operating mechanism shown in Fig. 1,

Fig. 3 is a sectional view on the line 3—3 of Fig. 2,

Fig. 4 is a view in side elevation of the operating mechanism of the artifical leg as in Fig. 1 except that the operating mechanism is in the locked position; and

Fig. 5 is a sectional view on the line 5—5 of Fig. 4.

In the following description and claims, various details will be identified by specific names for convenience. These names however are intended to be as generic in their application as the art will permit.

Referring now to the drawing forming a part of this specification more in detail, in which similar characteristics of reference indicate corresponding parts in the several views, and referring more particularly to the preferred form of my invention selected for illustrative pur-

poses, I have shown, as is usual in appliances of the general character of these herein disclosed, an artificial leg comprising three main elements, namely, the foot element **10**, the lower or intermediate leg element **12**, and the upper leg element **14**.

As is known, these elements are coupled together and arranged together so that various degrees of movement may be had by the user in lifelike simulation of a natural leg.

Such movement is normally aided by additional contrivances such as a controlling strap **16** connecting between the calf portion of the lower leg element **12** and the conventional supporting means for the apparatus such as a belt or a suspender worn by the amputee. Other contrivances may include a knee cord **18** connecting between the upper and lower leg elements, a secondary central strap **20** connecting between the thigh portion of the upper leg element **14** and the supporting means, and a socket member **21** which is shaped to fit the leg stump of the amputee when the device is in use.

Reference will first be made to Fig. 4 in connection with which the various components of the mechanism may best be defined.

Within a recess in the foot element **10** is fitted an ankle journal block **22** which is secured thereto as by bolts **24** and nuts **26**, as shown.

The ankle journal block **22** is provided with a pair of upwardly extending ears and aligned transverse openings therethrough through which an ankle pin **28** is extendable.

An ear **30** extends downwardly from the lower face of the lower leg element **12** and is disposed between the ears of the ankle journal block **22**. The ear **30** is provided with a transverse opening therethrough through which the ankle-pin **28** is receivable, wherefore the foot element **10** and the lower leg element **12** may be pivotally coupled together for the accomplishment of the desired flexing relationship.

That is, by the structure hereof, the foot element is coupled to the lower leg element for movement about the axis of the pin **38** in a radial manner. Thus is permitted a fore-and-aft swinging motion of the foot element relative to the lower leg element.

The recess in the foot element **10** is of such enlarged configuration as to receive within the top portion thereof the lowermost portion of the lower leg element in the normal position of the leg.

A resilient pad **32** of leather, rubber, or the like is fixed to a shoulder in the recess of the foot element **10** as by being fixed or welded or otherwise secured thereto. A similar resilient pad **34** is fixed to the lower face of the lower leg element **12**. The two pads are complemental to each other and may be compressed against each other in one extreme of the relative positions of the foot and lower leg elements as will subsequently be observed.

The foot element **10** is provided with a heel member **36** which is secured thereto by means of any integral forwardly disposed heel tongue **38** as by a screw **40** or similar securing means.

The heel member **36** is adapted to be flexed toward and away from the foot element **10** as will be observed.

The lower leg element **12** is hollowed interiorly and is provided with a shelf **44** which may be held relative to the lower leg element **12** as by one or more bolts **46** and nuts **48** as shown.

An upwardly extending yoke shaped or Y-shaped locking rod **56** is provided and has a lower stem portion which extends through an appropriate opening in the shelf **44**.

At the lower extremity of the locking rod **56**, a transversely extending button **58** is threadedly engageable therewith.

A lower sleeve **60**, generally oblong in cross section, has an elongated opening extending vertically therethrough, which opening is likewise oblong in cross section. The uppermost face of the sleeve is circular in shape so as to provide an annular lip which is seated on a shoulder of the recess in the foot element **10**. See Fig. 5.

The locking rod **56** is receivable through the elongated opening of the lower sleeve **60**.

The lower sleeve **60** is disposed directly above the button **58**. When the locking rod is in the locked position shown in Fig. 4, the topmost face of the button **58** abuts the lowermost face of the lower sleeve **60**.

An upper bushing **66**, having an elongated opening therethrough, is fixed by any conventional means to the shelf **44** and the locking rod **56** is extendable downwardly therethrough.

An ankle tension spring **70** is disposed around the locking rod **56** and has an upper end portion bearing against the shelf **44** and around the upper bushing **66** and has a lower end portion bearing against the uppermost face of the annular lip of the lower sleeve **60**.

The ankle tension spring **70** functions to push the heel portion of the foot element downwardly and to raise the toe portion thereof upwardly around the pivot **28** when the amputee lifts his artificial leg away from the ground when standing or off the floor when sitting.

A resilient pad **74** member is disposed around the locking rod **56** adjacent the upper side of the shelf **44** and an annular stop member **76** fixed to the locking rod **56** is adapted to bear thereagainst when the locking rod is urged to the lower limit of its stroke as will be presently observed.

A spring anchor **80** is fixed to each of the diverging arms of the locking rod as shown. A pair of spring members **82** are provided, the upper extremity of each being fixed to the related spring anchor **80** and a lower extremity fixed to spring anchor part **84** extending upwardly from the shelf and secured thereto by any suitable means. The spring members **82** normally urge the locking rod downwardly to its lower limit.

The upper extremities of the diverging arms of the locking rod **56** are offset so as to be receivable through a pair of aligned openings in a guide plate **86**. The guide plate is provided with an intermediate recessed portion **87** at its rear side thereof to receive the knee cord **18** during flexing movements.

The guide plate **86** has downwardly depending side arms, each of which is fixed to an opposite side wall of the lower leg element **12** as by bolts **90** and nuts **92**.

The upper leg portion **14** pivotally connected to the lower leg element by a pin **93** is provided with a locking plate **94** secured to the lowermost end thereof as by bolts **96** and nuts **98**.

The locking plate **94** is provided with a pair of openings therethrough through which the upper extremities of the arms of the locking rod **56** are receivable.

In operation, as the full weight of the amputee is put upon his good foot and as his weight is simultaneously relieved from the artificial foot so as to permit the heel **36** to be flexed downwardly away from the foot element, the locking rod is automatically unlocked. In such action, the springs **82** urge the locking rod downwardly, the downward travel being limited by the abutment of the stop **76** against the resilient pad **74**. Being unlocked the upper and lower leg elements are capable of being flexed relative to each other and the foot element can be flexed relative to the lower leg element. The foot element is swingable on the ankle pin **28** and the locking rod is movable within the oval slot of the lower sleeve **60**.

As soon as the step has been completed and the weight again is shifted to the artificial leg, the heel **36** is pushed upwardly relative to the foot element and urges the button **58** and the locking rod **56** upwardly relative to the upper leg element whereupon the upper extremities of the locking rod enter the openings in the locking plate **94** so as to lock the upper and lower leg elements together.

Thus while standing erect, the weight of the body may be upon one or both feet depending upon a particular stance of the user, but when the user starts to walk all of the weight of the body is at least momentarily on first one foot and then the other while the artificial leg is first locked and then unlocked.

When changing from a standing to a sitting position, the mere lifting of one heel after the other will effect the unlocking of the device and permit the knees to bend and a user to gracefully assume a sitting position.

When the leg is in weight-supporting relation to the foot and with the foot on the ground of course, the ankle and knee joints are relatively stiff. As the weight moves forward in the beginning of a stride, it moves somewhat faster than the knee joint so that the knee joint is caused to flex and appreciably faster than the ankle joint so that the ankle joint is likewise caused to flex, the said ankle joint being cocked through the pressure of concentration of pressure on the toe.

In the mechanism hereof, the above referred to stiffness at the ankle and knee joints of the artificial leg are provided by the locking rod which holds the upper and lower leg elements locked as to each other. The foot element is held rigid because same is resting squarely on the ground.

As the stride is begun with the mechanism hereof, the weight of the amputee moves forward as stated above and the rear portion of the leg element is accordingly lifted upwardly. The springs 82 thereupon urge the locking rod downwardly whereby the upper and lower elements are unlocked wherefore the knee joint flexes as noted above and the ankle joint is likewise caused to flex, also as noted above.

Continued forward motion results in a further, but lifelike, lag in the ankle, accompanying a slight accelerated motion of the knee. At this moment the upper leg is swinging somewhat as a pendulum and this action results in the swinging motion of the lower leg from a position rearwardly of the knee to a position more or less directly under the knee whereupon in the further continued forward motion of the stride, the upper and lower legs come into more or less alignment.

Such alignment as has been described results, in the case of the mechanism hereof, in the upper and lower leg elements come into such vertical alignment that, when pressure is applied to the heel, the locking rod is again projected upwardly to the assumption of the locked position.

It will be understood that the device of this invention may be applied to orthopedic appliances of present and existing designs and constructions with but slight modifications thereof, this invention being equally as well adopted for use therewith as with appliances of present or future design and construction made with the invention hereof principally in mind.

From the foregoing, the construction and operation of the device will be readily understood and further explanation is believed to be unnecessary. However, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction shown and described.

While I have illustrated and described the invention as embodied in certain specific arrangements, it will be understood by those skilled in the art that the object of the invention may be attained by use of constructions different in certain respects from those disclosed without departing from the underlying principles of the invention.

I do not intend to be limited to the details shown since various suitable modifications and variations in structural changes may be made without departing in any way from the spirit of the invention. I therefore desire by the following claims to include within the scope of my invention all such suitable variations, modifications and equivalents by which substantially the results of my invention may be obtained through the use of substantially the same or equivalent means.

Without further analysis, the foregoing is intended to so fully reveal the gist of my invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention, and therefore, such adaptations should and are intended to be comprehended within the meaning range of equivalence of the claims below.

What it is desired to claim and secure by Letters Patent of the United States is:

1. In an orthopedic appliance for an amputee including upper and lower leg elements and a foot element wherein the upper leg element is attachable to the leg of the amputee at a point above the knee joint, the improvement comprising, a Y shaped locking rod vertically extendable through the lower leg element, a locking plate fixed to the upper leg element, the upper extremities of said locking rod being receivable through aligned openings in said locking plated during the locked position of the upper and lower leg elements, a flexible heel hingedly connected to the foot element and being movable upwardly into embracing relationship with said foot element as said foot element engages the ground by the action of the amputee in placing the weight of his body on the orthopedic appliance to drive said locking rod upwardly for effecting locking engagement of the lower and upper leg elements, and spring means for urging said locking rod downwardly away from said locking plate as the amputee lifts the appliance off the ground.

2. In an artificial leg, an upper leg element attachable to the stump of the leg of the amputee, a lower leg element being pivotally engageable with said upper leg element, a foot element being pivotally engageable with said lower leg element, a vertically-disposed locking rod extendable through said lower leg element and having an upper end extendable into said upper leg element and a lower end extendable into said foot element, a horizontally-disposed locking plate secured to said upper leg element, said locking rod being releasably engageable with said locking plate, primary spring means for urging said locking rod downwardly away from and out of engagement with said locking plate and secondary spring means for urging said foot element downwardly around the pivotal connection with said lower leg element under no-load conditions and a flexible heel member hingedly connected to said foot element and engageable with said locking rod for urging said locking rod into locking engagement with said locking plate under load conditions.

3. In an artificial leg, an upper leg element being attachable to the stump of the leg of the amputee, a lower leg element being pivotally engageable with said upper leg element, a foot element being pivotally engageable with said lower leg element, a vertically extending locking rod extendable through said lower leg element, an apertured horizontally-disposed locking plate secured to said upper leg element for receiving the upper extremity of said locking rod and holding said upper and lower leg elements in locked engagement relative to each other, primary spring means for urging said locking rod downwardly away from and out of locking engagement with said locking plate, secondary spring means for pivoting said foot element around its pivotal connection with said lower leg element under no-load conditions and a flexible heel member hingedly connected to said foot element and engageable with said locking rod for urging said locking rod into locking engagement with said locking plate, under load conditions.

4. In an orthopedic appliance for an amputee including articulated upper thigh and lower leg and foot elements, the improvement of means for locking the articulation between the upper thigh and lower leg elements while permitting the rotation of the foot element relative to the lower leg element as the amputee places the

weight of his body on the orthopedic appliance as in walking comprising, a shiftable locking rod carried by and within the lower leg element, a stationary locking plate carried by and within the upper thigh element, a spring member having an upper end receivable against a fixed component of the lower leg element and a lower end receivable against a fixed component of the foot element for pivoting the foot element, around its pivotal connection with the lower leg element, a spring member disposed between said locking rod and the fixed component of the lower leg element for effecting a downward thrust of said locking rod downwardly away from and out of locked engagement with said locking plate, as the weight of the amputee on the orthopedic appliance is relieved therefrom and placed on his other leg, and a flexible heel member hingedly connected to the foot element and engageable with said locking rod for effecting an upward thrust of said locking rod into locked engagement with said locking plate under load conditions as the weight of the amputee is placed on the orthopedic appliance for maintaining the upper thigh and lower leg elements in locked engagement with each other.

5. In an orthopedic appliance for an amputee including articulated upper thigh and intermediate calf and lower foot members, the improvement in means for aiding the walking of the amputee by alternately preventing articulation between the upper thigh and intermediate calf members as the amputee assumes the load condition by the placement of his body weight on the orthopedic appliance and permitting articulation between the upper thigh and intermediate calf members as the amputee assumes the no-load condition by the placement of his body weight on his natural leg comprising, a vertically shiftable locking rod mounted in the intermediate calf member, a latching plate mounted in the upper thigh member, a flexible heel member hingedly connected to the lower foot member and engageable with said locking rod for effecting an upward thrust of said locking rod into releasable engagement with said latching plate to hold the upper thigh member in fixed axial alignment with the intermediate calf member under the load condition, and spring means connecting between said locking rod and the intermediate calf member for effecting a downward thrust of said locking rod out of releasable engagement with said latching plate under the no-load condition.

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