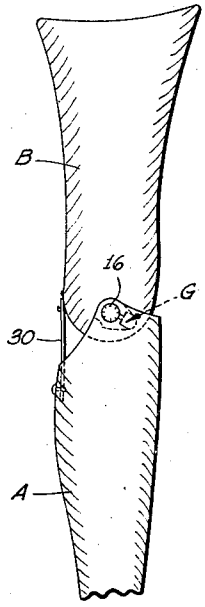
Oct. 3, 1939. J. H. F. STEWART 2,175,136

ARTIFICIAL LEG

Filed May 9, 1939

FIG. 1.



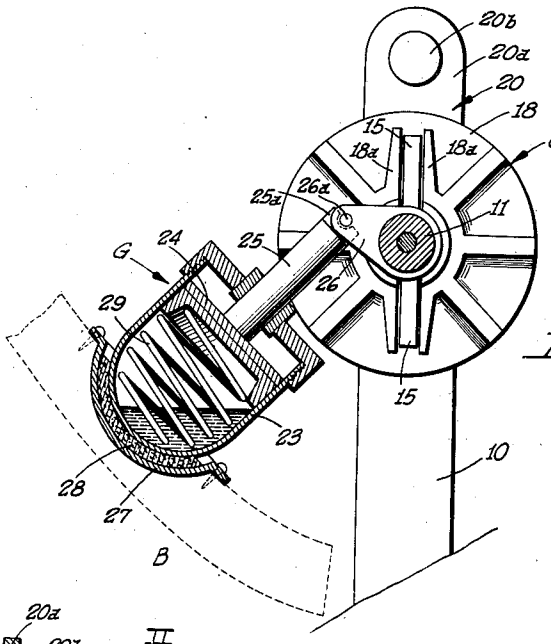
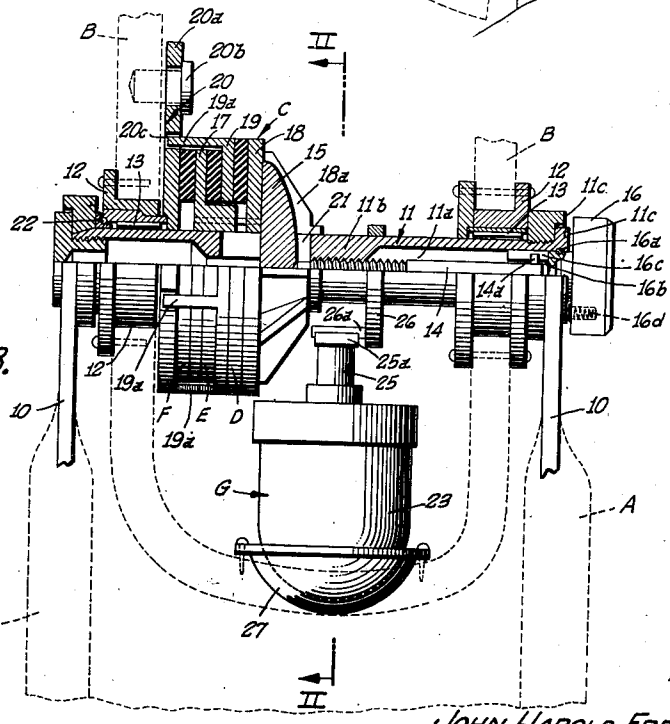


FIG. 2.

FIG. 3.



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Patented Oct. 3, 1939

2,175,136

UNITED STATES PATENT OFFICE

2,175,136

ARTIFICIAL LEG

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Application May 9, 1939, Serial No. 272,655
In New Zealand August 20, 1937

2 Claims. (Cl. 3—2)

My invention relates to improvements in artificial legs and has particular reference to knee operating mechanisms employed with artificial legs which include articulated thigh and shin members.

In the construction and use of articulated artificial legs, it has been the common practice to pivotally join the thigh and shin portions of the leg so as to provide a bendable knee therein adapting the leg to bend and straighten as the user thereof assumes natural positions and movements of walking. Heretofore the artificial leg constructions and apparatus for restoring the leg to a straight line position after bending in natural walking movements have been such as to provide a jerky forward motion of the shin portion of the leg, making the resultant motions awkward and unnatural.

It is therefore an object of my invention to provide a knee joint and operating mechanism therefor in which the forces exerted in bending the knee are stored during the bending movement and are controllably released to swing the shin portion back to a straight line arrangement with respect to the thigh portion of the leg.

Another object of my invention is to provide a structure of the character set forth in the preceding paragraph wherein the rate at which the stored forces may be released may be readily varied in accordance with the normal motion of the particular wearer to thereby provide a more natural appearance to the action of the artificial limb.

Other objects and advantages of my invention will be apparent from a study of the following specifications, read in connection with the accompanying drawing, wherein—

Fig. 1 is a side view of the thigh and upper shin portion of an artificial leg;

Fig. 2 is a sectional side view of the knee operating mechanism, on the line II—II in Fig. 3 looking in the direction of the arrows, the crank for operating and connecting the braking means to the clutch axle being also included; and

Fig. 3 is a front view of the knee operating mechanism, the top half being in section.

In the drawing, the shin portion A of the artificial leg is pivoted to the thigh portion B. Two side irons 10 on the former part extend up from the main shin portion, one on each side of the latter, and a hollow axle 11 extends through the thigh portion and is secured at its ends in the side irons 10 towards the tops thereof. This hollow axle 11 is securely locked into the side irons so that it rotates with the shin portion A and in order that it may do so evenly and without noise, the axle, where it passes through the sides of the lower end of the thigh portion B, is journaled in bearings 12 mounted in the thigh portion, the bearings being riveted, or otherwise secured, in the thigh member. Between the bearings and the axle, roller bearings are arranged which in the drawing are shown as needle races 13.

Mounted on the axle, but inside the thigh portion B of the leg, is a clutch mechanism, by means of which a varying resistance may be applied to the movement of the leg at its pivot of the knee joint.

The simplest form of constructing this clutch mechanism comprises a plate mounted to loosely encircle the axle but rigidly fixed to one of the inside faces of the thigh portion. A second plate is also mounted on this axle and is so keyed to it that while revolving therewith it may also move longitudinally thereon. A rod operated by a thumb screw projecting at one end of the axle is used to thrust the two plates together with varying intensity to control the freedom with which the knee joint may move.

In the preferred form, though it is to be understood that the invention is not limited to this construction, the clutch C is made on the lines illustrated in the drawing. In this case two plates 17 and 18 are locked to each other at a distance apart on the axle 11 in a manner to allow for the space between widening or narrowing, and these are locked to the axle 11 against relative rotative movement, but allowing movement along the axle, by means of a key plate 15 that is situated upon the outer side of the plate 18 and fits between radial lugs 18a thereon and which passes diametrically through a longitudinally extending slot 21 formed in the axle length and is thus capable of movement along within such slot.

Combining with these plates 17 and 18 are two plates 19 and 20 which are arranged so that plate 19 is between the plates 17 and 18 while plate 20 is on the inner side of plate 17 and is adjacent to the inside face of the thigh portion B through which the axle 11 passes. This latter plate 20 is securely fastened to such thigh portion by means of a stud screw 20b passing through a lug 20a formed on the edge of the plate, while the plate 19 is locked in rotative engagement with the plate 20, but in a manner to allow of freedom of movement along the axle, by means of lug fingers 19a extending transversely from its periphery, outside the edge of plate 17 and fitting into notches 20c in the edge of plate 20. The adjacent faces of these plates may be separated by the

employment of rubber or leather, or like friction washers D, E and F.

Thus by pressing this series of plates 17 and 18 toward or away from each other to a greater or less extent, the freedom of movement of the shin portion in its pivoting on the thigh portion may be regulated in degree to any desired resistance.

For thus pressing the plates together, a thrust rod 14 is provided to enter a longitudinal bore 11*a* extending from one end of the shaft 11 and engaging internal threads formed upon an inward radially extending portion 11*b* of the shaft so that its inner end engages the aforesaid key plate 15 and by screwing the rod 14 inwardly, the plate 18 may be moved toward the plate 20 to increase the braking action therebetween. Reverse rotation of the rod 14 will relieve this pressure and lessen the braking action.

A thumb piece 16 projects into the open end of the bore 11*a* and is secured therein against accidental removal by means of a spring ring 16*a* interengaging cooperating grooves formed upon the thumb nut 16 and the interior of the shaft 11. This thumb nut 16 is provided with a longitudinal bore 16*b* in which is received the free end of the threaded rod 14, slots 16*c* being formed upon opposite sides of the bore 16*b* in which is received a key or pin 14*a* secured to or formed upon the free end of the rod 14. Thus rotation of the thumb nut 16 will impart a rotary motion to the rod 14, while permitting the rod 14 to move inwardly and outwardly in the shaft 11 without altering the inward or outward position of the thumb nut 16. In order to retain the desired pressure and to also give an audible indication of the amount of additional or less pressure being applied to the clutch when being adjusted, a spring loaded ball 16*d* is mounted in the inside face of the nut 16 and this is designed to locate and audibly click into any one of a series of depressions 11*c* formed upon the outer face of a head 11*d* employed to hold the free end of the shaft 11*b* against longitudinal movement.

The pressure of the side thrust on the clutch member C would tend to force the side of the thigh near it against the side iron 10 extending from that side of the shin portion A and to prevent these surfaces jamming a thrust bearing 22 is interposed between them.

Preferably combined with the aforementioned knee joint mechanism are means for causing an additional automatic braking of a portion of the movement of the shin portion in relationship to the thigh portion and subsequently utilizing the power stored in effecting that braking to move the shin for the rest of its forward movement in the normal walking step by means of which the walking action of a natural leg may be simulated by the wearer of the artificial leg.

The means for producing this effect comprise the use of a small air compression and release means G. This comprises preferably a cylinder 23 having one of its ends made of a semi-spherical shape. A plunger 24 is mounted to reciprocate in this cylinder and is adapted to be forced forward by a plunger rod 25 to compress the air in the cylinder.

The air compression cylinder D is so suspended inside the thigh portion of the artificial limb that the outer end of the plunger rod 25, which may be in the form of a T-shaped head 25*a*, contacts and is supported by a pin 26*a* on a crank 26 rigidly mounted upon and projecting out from the axle 11 about which the leg pivots. The semi-spherical end of the cylinder 23 rests in a cup-shaped member 27 rigidly mounted on the inside face of the thigh member B so that the cylinder end may rock therein. This cup is lined with leather, or the like cushioning material 28 to deaden any noise from such movement.

A spring 29 is mounted in the cylinder 23 inside the plunger 24 to ensure that the plunger rod outer end will always bear against the crank pin 26*a*. In addition, a quantity of oil is stored within the cylinder to lubricate this plunger 24.

An adjustable back strap 30 is used to prevent the portion A of the leg swinging forward beyond a straight line with the portion B. When the portion A is doubled back slightly behind the line of the thigh B, this strap 30 folds up neatly.

In use, as the wearer commences his stride forward with the artificial leg, the thigh portion is first carried forward with the body while the toe remains on the ground. This means that the leg will bend at its pivot or knee joint. The completion of the forward step is then made by lifting the toe off the ground and allowing the shin portion to swing forward quickly until it is in line with the thigh, and usually the now straightened leg is carried a little further forward and the foot is then placed on the ground slightly in advance of the body.

The cylinder D is so interposed between the socket 27 and the axle 11 that at the commencement of the forward movement of the leg, that is, the initial bending of the knee, the plunger 24 and rod 25 will be in their out position, and as the thigh portion B moves forward, bending the knee joint, the plunger will be forced in to compress the air in the cylinder. As the forward movement continues, the toe of that leg leaves the ground and the compressed air in the cylinder will serve to force the plunger out again, the plunger rod rotating the axle for a short distance to quickly swing the shin into line again with the thigh for the completion of that step. This moving in and out of the plunger is effected by the crank 26 which, as the axle 11 rotates, will be moved from a position in which the pin thereof is a distance out of alignment with the cylinder and the axle until it assumes a line in between them, in which latter position it will have forced the plunger down into the cylinder. When the toe of the shin is released from contact with the ground, the crank will be forced back by the compressed air in the cylinder into its original position, turning the axle 11 to which it is secured. At the same time as the crank and its pin moves down on the bending of the knee joint, the thigh member, moving about the axle, will cause the socket 27 mounted thereon to move up until at the normal full walking bend of the cylinder 23, the rod 25, the crank 26 and the center of axle 11 will all be in approximately a straight line. As the shin A swings forward to align with the thigh B, the cup 27 and the cylinder will move down again, while the crank outer end will be forced up.

The air compressed in the cylinder in the first movement of the foot will thus serve to move the shin portion forward into alignment with the thigh portion without any effort on the part of the wearer of the leg and will eliminate an awkward jerking movement that is now necessary with artificial legs at present in use.

The adjustment of the compression period, or braking action, of this joint may be effected easily by the wearer to suit his particular walking style, simply by altering the position of the crank on the axle 11. This may be done by suitable set screws.

This air compression cylinder, in combination with the clutch, will serve to form a brake to check the excessive bending of the knee, the clutch portion of the mechanism providing a constant braking or resistance for all the movement of the knee joint, while the compression mechanism gives an added brake for a portion only of that movement and then assists for a further portion of the movement of the leg to restore the bent leg to its position when the shin portion is in line with the thigh.

Other forms of linking the compression cylinder to the axle of the clutch may be used as long as they provide for the depression and return of the plunger on the movement of the knee joint. The position of the location of the cup 27 in the thigh portion may vary according to the particular characteristics of the stump to which the leg is to be fitted. For instance, in Figs. 1 and 2 of the drawing, the cylinder is located in its socket at a position between the horizontal and the vertical lines of the axle, while in Fig. 3 of the drawing, the cylinder is vertically below the axle 11. In all cases the crank 26 is so adjusted on the axle 11 in relationship to the position of the socket 27, that when the knee joint is bent to its full extent under normal walking conditions, the plunger will be forced down in the cylinder and the plunger rod crank and axle will be in practically a straight line; in other words, the crank and plunger rod will have nearly reached the dead center, whereas when the leg is straightened out, the crank will be moved a considerable distance out of alignment with the cylinder and the axle.

In addition, while the compression cylinder combines best with a clutch mechanism of the kind described, it is not to be limited to this combination only, but may be combined with other forms of friction devices mounted on or connected to the pivot axle, as for instance a type embodying a brake drum and strap.

While I have shown and described the preferred embodiment of my invention, I do not desire to be limited to any of the details of construction shown or described herein, except as defined in the appended claims.

I claim:

1. In an artificial leg including articulated thigh and shin members, the combination therewith of a shaft pivotally interconnecting said members to define a knee joint therebetween, means interposed between and coupled to said thigh and shin members and actuated upon bending of said knee joint for storing energy tending to return said thigh and shin members toward straight line positions relative to each other, and means for imposing a constant braking force between said thigh and shin members to retard the movement of said members toward said straight line position, comprising a set of plates surrounding said shaft, one of said plates being coupled to said shaft, another plate being coupled to one of said members, means rigidly connecting said shaft to the other of said members, and means extending through said shaft and being operably engaged with one of said plates for regulating the braking force applied between said members.

2. In an artificial leg including articulated thigh and shin members, the combination therewith of a shaft pivotally interconnecting said members, means rigidly connecting said shaft to one of said members, means interconnecting the other of said members and said shaft and actuated upon movement of said thigh and shin members from a straight line position for storing energy tending to return said members toward said straight line position, brake means interposed between said shaft and said other of said members for continuously exerting a braking force retarding movement of said members relative to each other, said brake means including a plurality of sets of plates surrounding said shaft, one set of plates being nonrotatably coupled to said shaft and the other being nonrotatably coupled to said other member, a slot through said shaft and extending longitudinally therealong, a key extending through said slot and engaging one of said sets of plates, and screw means threaded into said shaft for bearing on said key for adjustably urging said sets of plates relative to each other.

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