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SELF-LOCKING AND UNLOCKING PIVOT JOINT FOR LEG BRACES

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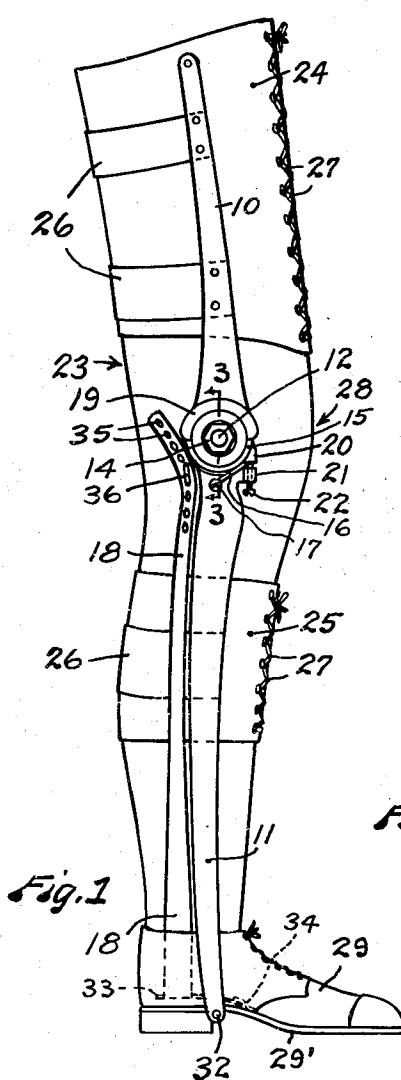


Fig. 2

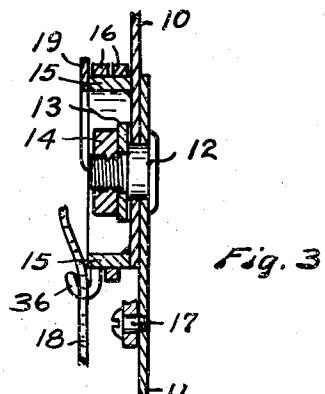
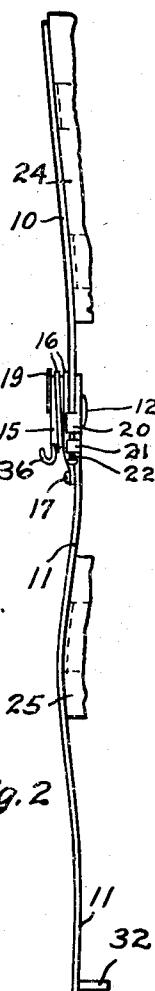


Fig. 3

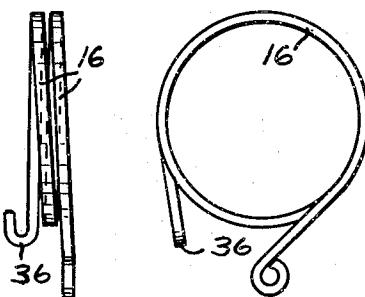


Fig. 4

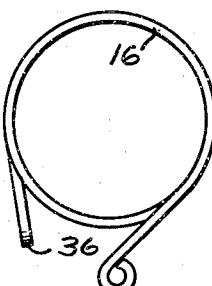


Fig. 5

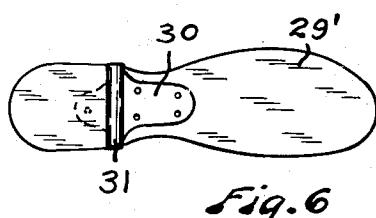


Fig. 6

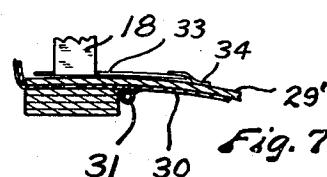


Fig. 7

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SELF-LOCKING AND UNLOCKING PIVOT JOINT FOR LEG BRACES

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3 Claims. (Cl. 128—80)

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This invention relates to a leg brace and an object of this invention is to provide a leg brace having a pivotal knee joint which is self-locking and self-unlocking depending on the position of the foot of the user and the amount of weight supported on the leg.

Another object of this invention is to provide a leg brace having an articulated knee joint which is automatically controlled by the position of the foot and by variations in the amount of weight placed on the leg on which the brace is worn and which offers slight resistance to normal bending of the knee when little or no weight is supported on the leg but offers an increased amount of resistance to normal bending of the knee proportional to the weight supported on the leg and borne by the heel portion of the foot.

Another object of the invention is to provide a leg brace which will make it possible for a person who has a knee which bends too easily to control that knee and walk in a substantially normal manner and to support weight on the leg while in a squatting position.

Another object of this invention is to provide a leg brace comprising an upper and a lower brace member pivotally articulated together in end to end relation and provided at the location of their pivotal connection with a drum having thereon a resilient helical metal band which normally does not grip the drum but which is connected with the foot of the user by weight operated means which will tighten the band on the drum and increase the resistance to pivotal movement of the two brace members when the leg on which the brace is worn is subjected to weight and this weight is borne on the heel portion of the foot.

Other objects of this invention are to provide a leg brace having a pivotal joint provided with automatic weight controlled means of simple and efficient and reliable construction which will operate automatically to vary the resistance to bending of the pivotal joint.

Other objects of this invention will be apparent from the following description taken in connection with the accompanying drawings.

In the drawings

Figure 1 is a side elevation of a leg brace constructed in accordance with this invention showing the leg brace as it may appear when on a leg.

Fig. 2 is an edge view with parts broken away, showing the brace members on one side of the leg brace and showing part of the control means.

Fig. 3 is a sectional view of the pivotal joint of this leg brace, taken substantially on broken line 3—3 of Fig. 1 and on a larger scale than Fig. 1.

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Fig. 4 is a detached edge view of a resilient helical metal band used to control the pivotal joint of this leg brace.

Fig. 5 is an elevation of the resilient helical metal band shown in Fig. 4.

Fig. 6 is a bottom plan view of a shoe sole which is equipped with a pivot plate used in connection with this invention.

Fig. 7 is a fragmentary side view, with parts in section showing a footplate used inside of a shoe in connection with this invention.

Like reference numerals designate like parts throughout the several views.

This leg brace comprises an upper brace member 10 and a lower brace member 11 having overlapping end portions which are pivotally connected together, preferably by a shouldered bolt 12 having a washer 13 and a nut 14 thereon.

An externally cylindrical drum 15 is rigidly secured to one of the brace members, such as the brace member 10, coaxially of the pivot bolt 12. The brace members 10 and 11 are preferably made of relatively light weight but strong metal and the drum 15 can be welded or riveted or otherwise rigidly attached to one of these brace members. A resilient helical spring type metal band 16, preferably consisting of more than one complete coil or turn of spring wire is disposed around the drum 15 and has one end portion thereof secured, as by a screw 17, to the brace member 11 which is pivotally movable relative to the drum 15. The other end portion of the resilient helical metal band 16 is connected with a flexible tension exerting member 18 through which tension may be exerted on the band 16 to cause said band 16 to grip the drum 15. Preferably the resilient helical metal band 16 is of rectangular or square cross section, as shown in Figs. 3 and 4, to provide on said band a flat surface for more efficient gripping engagement with the outer circumferential wall of the drum 15.

Preferably a guard flange 19 is secured to at least the upper portion of the drum 15 and overhangs said drum 15 to prevent sidewise displacement of the band 16 from said drum 15.

Also preferably adjustable means are provided to limit backward pivotal movement of the pivotally connected end portions of the brace members 10 and 11. One way to accomplish this is to provide on one of the brace members, such as the brace member 10, a rigid stop shoulder 20 and to provide on the other brace member 11 a lug 21 having a stop screw 22 adjustably threaded therethrough. The stop screw 22 is positioned so that the end thereof will engage with the

shoulder 20 and limit or stop the relative pivotal movement of the brace members 10 and 11 which occurs when the user of the brace straightens out his leg.

The resilient band 16, having one end portion connected with the brace member 11, is arranged in such a manner that it will tend to resist normal forward bending movement of the knee of the user whenever tension is exerted on the other end portion of said band 16. Obviously this band will not tend to resist pivotal movement of the brace members 10 and 11 in the opposite or rearward direction. The band 16 extends helically more than one full turn around the drum 15 and if tightened thereon will grip like a clutch to resist movement of the drum in one direction.

The brace members 10 and 11 are preferably attached to the leg 23 of a user in a conventional way by the use of an upper leg band 24 and a lower leg band 25. These leg bands 24 and 25 are usually of leather or canvas and semi-circular metal members 26 are used in connection with these parts 10, 11, 24 and 25. Lacing 27 can be used to secure the bands 24 and 25 to the leg. The pivot bolt 12 is normally positioned in substantial alignment with a transverse axis which passes through the joint of the knee 28 of the user.

Usually the brace members 10 and 11 are in duplicate at the outside and the inside of the leg. Ordinarily it will be sufficient to provide this weight controlled locking means or friction means in connection with the brace members 10 and 11 at one side of the leg only but the same may be provided at both sides of the leg if desired.

The lower end portion of each lower brace member 11 is pivotally attached to the sole and heel portion of a shoe 29. One preferred way to do this is to fixedly secure to the bottom of a shoe sole 29', see Fig. 6, a metal plate 30 which is provided with a transverse tube 31 and to provide on the lower end portion of each lower brace member 11 a rigidly mounted transverse bearing pin 32 which fits into the tube 31. Preferably the bearing tube 31 is positioned in the arch portion of the shoe closely adjacent the heel.

The lower end portion of each tension exerting member 18 extends into the shoe 29 and is secured to the rear end portion of a footplate 33, Fig. 7, which is worn in the shoe. Preferably the footplate 33 is of thin metal and preferably the forward end portion of this footplate is hingedly connected with the inner sole of the shoe, as by means of a strip 34 of flexible material which has one edge portion secured to the footplate and the other edge portion secured to the inner sole of the shoe. The rear end portion of the footplate 33 to which the tension exerting member 18 is secured is positioned under the heel portion of the foot. The shoe is laced loosely enough so that there will be some up and down movement of the heel portion of the foot in the shoe when the person wearing the shoe is walking or moving around on his feet. This up and down movement of the heel portion of the foot in the shoe is utilized to control the knee joint locking means so as to lock said locking means when weight is supported on the leg and unlock said locking means when little or no weight is supported on the leg. Obviously the locking means can be made to respond in different ways to variations in the amount of weight supported on the leg. For instance, the band 16 and tension exerting means 18, 33 can be constructed

and arranged to positively lock the joint provided by the pivot member 12 or they can be arranged to exert a greater or less degree of frictional resistance to forward bending movement of this joint.

The effective length of the tension member 18 between its point of connection with the band 16 and its point of connection with the footplate 33 can be varied. One way to do this is to provide, in the upper end portion of the tension member 18, spaced apart holes 35 for selective engagement with a hook member 36 on the end of the band 16. This provides an adjustable connection which is easily reached and adjusted by the user.

In the operation of this device the inherent resiliency of the helical band 16 will cause this band 16 to expand and release the drum 15 when little or no tension is being exerted on said band 16 by the flexible member 18. The tension member 18 is normally adjusted so that it is tight enough to frictionally clamp the band 16 on the drum 15 when substantial weight is transmitted through the heel of the foot to the footplate 33. The shoe 29 is preferably tied loosely so that when the user starts to lift the foot in walking there is a tendency to lift the user's heel within the shoe and thus slacken the pull on the tension member 18 and release the band 16. Also the resilience of member 16, acting through the tension member 18 and brace 11, helps to relatively move apart the heel portion of the foot and the sole portion of the shoe when the leg is relieved of weight. The lower brace member 11, being pivoted to the shoe heel, is under compression when member 18 is under tension and this helps to provide relative movement between the heel of the foot and the drum 15 and this movement controls the application of the band 16 to the drum. When weight is placed on the leg so as to be borne by the heel portion of the foot the heel will move downwardly in the shoe and enough tension will be exerted on the tension member 18 to overcome the expansive force of the band 16 and tighten the same on the drum 15. The user can release the tension on the member 18 and thus release the band 16 from the drum by raising the heel of the foot relative to the heel portion of the shoe.

When a person having a weak knee joint is using this brace the pivotal joint of the brace will always be set when weight is being supported through the leg on the heel portion of the foot and will always be released when little or no weight is being borne by the heel portion of the foot. This brace thus enables a person with a weak knee joint to walk in a substantial normal manner as the pivotal joint of the brace will always be locked when the heel encounters the ground in making a step forward and will remain locked as long as substantial weight is borne on the heel of the foot and will be unlocked when the weight is taken off of the heel of the foot preparatory to swinging the leg forwardly.

The foregoing description and accompanying drawings clearly disclose a preferred form of this invention but it will be understood that this disclosure is merely illustrative and that changes may be made within the scope and spirit of the following claims.

We claim:

1. In a weight operated leg brace for use in connection with a shoe, two substantially rigid brace members adapted to be worn on the leg and having two overlapped end portions adapted

to be positioned alongside of the knee; pivot means pivotally connecting said two overlapped end portions for bending movement synchronously with the knee; a drum rigid with one of said brace members and positioned coaxially of said pivot means; other pivot means connecting the lower end of the lowermost brace member with the heel portion of a shoe; a resilient helical spring type band extending around said drum; means fixedly securing one end portion of said band to the brace member which is pivotally movable relative to said drum; tension member connected with the other end portion of said band; and tension exerting means connected with said tension member and adapted for engagement with the heel portion of the foot, whereby a pull will be exerted on said tension member to tighten said band on said drum and thereby resist relative angular movement of said two brace members in one direction when weight is supported on the heel portion of the foot.

2. A weight controlled self locking leg brace comprising an upper and a lower brace member adapted to be worn on the leg and having two adjoining end portions which are pivotally connected together; means adapted to pivotally connect the lower end portion of the lower brace member with the sole portion of a shoe at the location of the heel; means adapted to secure the respective brace members to a leg above and below the knee respectively with the pivotal connection of said brace members coinciding with the knee joint; a drum rigid with one of said brace members and positioned coaxially of the pivot which connects said two brace members; a helical spring type resilient band extending around said drum and having one end portion thereof secured to the brace member which is angularly movable relative to said drum; a tension member connected with the other end portion of said band; and a tension exerting member connected with said tension member and adapted to be positioned in the bottom of a shoe for engagement with the heel portion of a foot, whereby a pull

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will be exerted on said tension member to frictionally apply said band to said drum and thereby resist relative angular movement of said two brace members in one direction when weight is supported on said tension exerting member.

3. A leg brace for use in connection with a shoe comprising an upper and a lower brace member having adjoining pivotally connected end portions; a drum rigid with one of said brace members and positioned coaxially of the pivotal connection of the two brace members; a normally disengaged helical band extending around said drum and having one end portion thereof anchored to the brace member which is free from the drum; a tension member connected with the other end portion of said helical band, whereby said band may be frictionally applied to said drum to resist relative angular movement of said brace members in one direction only by the exertion of a pull on said tension member; stop means limiting relative angular movement of said brace members in the opposite direction; pivot means connecting the lower end portion of the lower brace member with the heel portion of a shoe; and heel engaging means connected with said tension member and movable within the shoe with which the lower end of the lower brace member is pivotally connected and positioned to receive the heel of a foot within the shoe, whereby weight applied by the heel of the foot to said tension member will frictionally apply said band to said drum.

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