

[54] **ORTHOTIC-PROSTHETIC
TRANSVERSE ROTATOR**

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128/583, 36/2.5 R

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[58] Field of Search **3/1**, 2, 21;
128/583-584, 80 R, 83.5; 36/2.5 R, 39

[56] **References Cited**

UNITED STATES PATENTS

3,481,332	12/1969	Arnold	128/83.5
2,264,570	12/1941	Holden	128/83.5
759,665	5/1904	Buff	36/39

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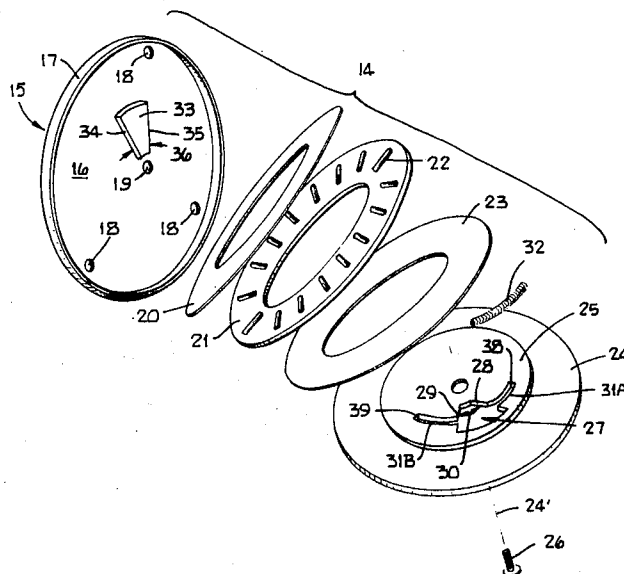
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[57]

ABSTRACT

A transverse rotator for an orthotic and/or prosthetic limb. The rotator has a mount connectable to the limb with a ground engageable means being rotatably connected to the mount. A projection and a first and second stop are provided in the rotator to limit the rotation of the ground engageable means with respect to the mount. Means bearingly space the mount and ground engageable means apart. A spring is provided to return the ground engageable means to the normal position. The amount of rotation of the ground engageable means may be varied. A pair of racer plates are positioned on either side of the means which bearingly space the mount and ground engageable means apart.

10 Claims, 4 Drawing Figures



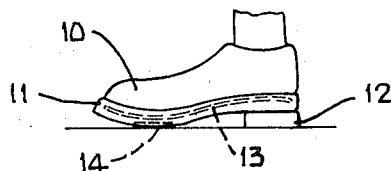


Fig. 1.

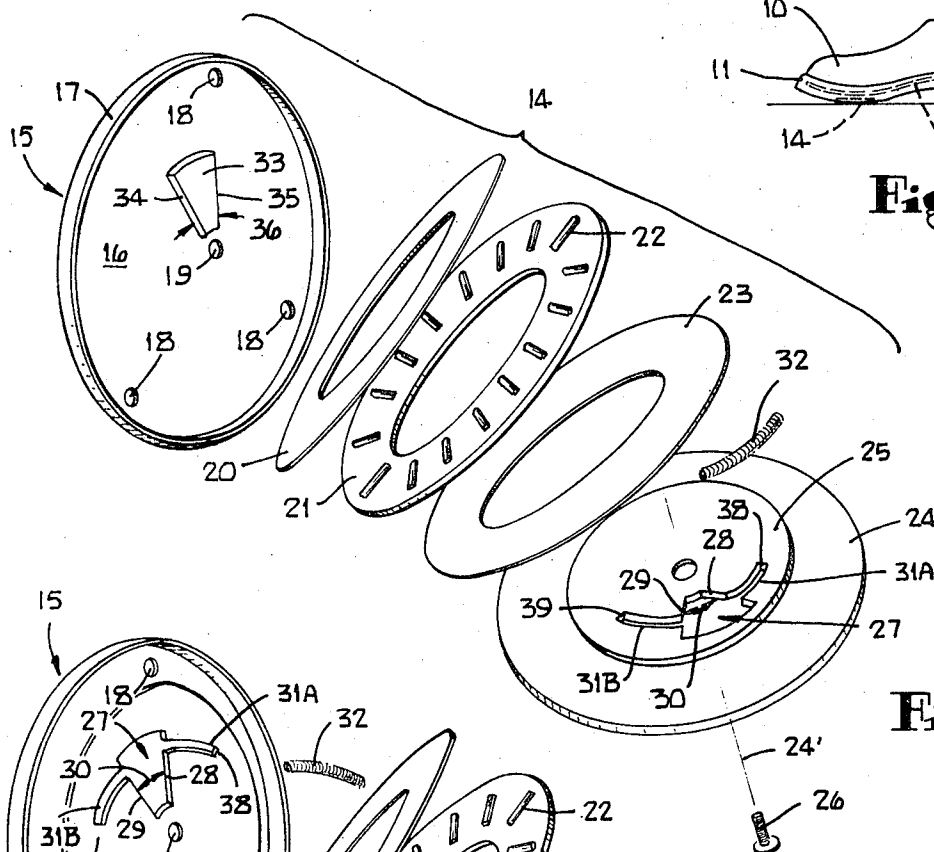


Fig. 2.

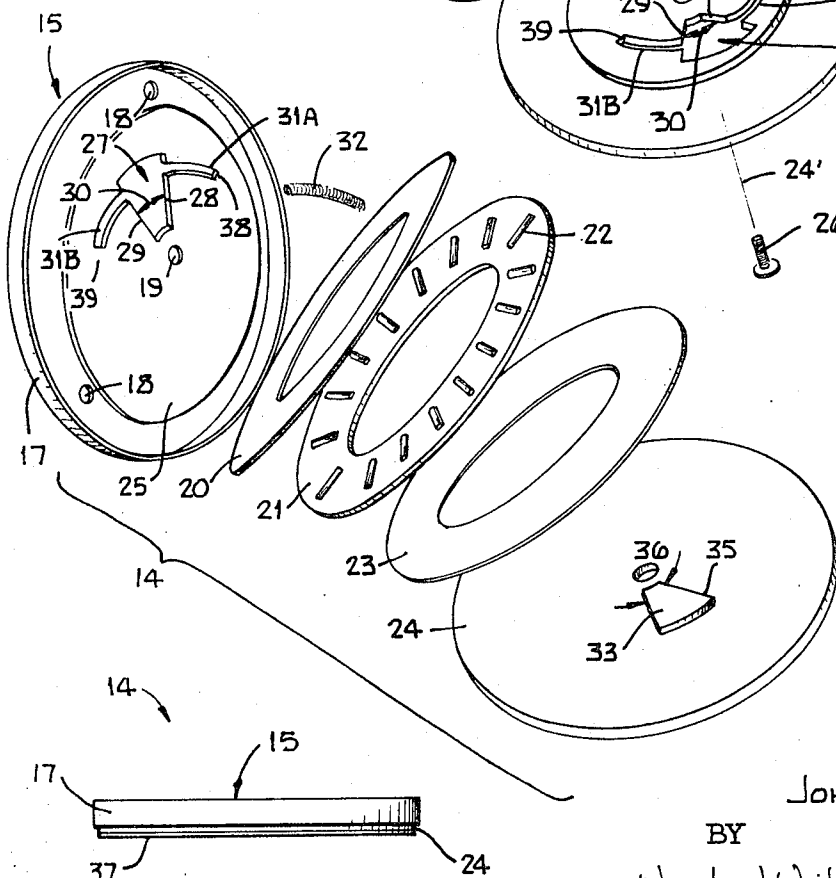


Fig. 3.

Fig. 4.

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ORTHOTIC-PROSTHETIC TRANSVERSE ROTATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention is in the field of devices which relate to the ambulation of the orthotic and/or prosthetic patient.

2. Description of the Prior Art

Disclosed herein is a transverse rotator which has been devised for the orthotic and/or prosthetic patient. The action of the rotator is exactly the same for the orthotic patient as for the prosthetic patient; however, the purpose served by the rotator to these two types of patients is quite different. To the unilaterally involved orthotic patient the rotator provides the means of rotating the body forward, in the transverse plane, when the involved lower extremity is in the stance phase of the walking cycle. To the bilaterally involved orthotic patient the transverse rotators serves, in the same manner, as a means of forward progression which is economical both in energy consumption and gadgetry. To both the unilateral and bilateral amputee, the rotator mechanically provides the anatomic transverse rotation lost because of the amputation of various segments. Presently the loss must be absorbed with each step by the twisting of the fleshy portions of the stump within the stump socket of the prosthesis. The twisting of surface tissues within the prosthesis has been felt for a number of years to be one of the major causes of irritation and breakdown of stump tissues. The mechanical rotator will relieve the stump tissues of 71 percent of this torsion or "twisting" for the AK amputee and 90 percent for the BK. The importance to the patient of relieving the stump tissues of these torsional forces when diabetes or vascular disease is present is self-evident.

Several devices have been provided for allowing rotation of a leg which is confined in a plaster of paris cast. For example, the U.S. Pat. No. 3,481,332 issued to M. L. Arnold discloses a rotator which is incorporated into a cast. Several embodiments of the rotator are disclosed in the Arnold patent. A device similar to the Arnold device is disclosed in the U.S. Pat. No. 2,264,570 issued to E. P. Holden with another similar device being disclosed in the U.S. Pat. No. 2,401,068 issued to E. D. Green. Another approach to rotation is shown in the orthopedic shoe construction disclosed in the U.S. Pat. No. 3,470,879 issued to T. J. Meiller. None of these devices have been constructed in view of the needs of the paralytic and/or prosthetic patient. The rotator disclosed herein fulfills such needs.

SUMMARY OF THE INVENTION

One embodiment of this invention is rotator for a limb comprising a mount connectable to the limb, ground engageable means rotatably mounted to the mount about an axis of rotation with the means having a first and second stop; means bearingly spacing the mount and the ground engageable means apart; a projection fixedly connected to the mount and movable about the axis between the first and second stop and spring means mounted on the ground engageable means and operable to normally urge the projection against the first stop but yieldable to allow the projection to abut the second stop as the ground engageable means rotates with respect to the mount.

Another embodiment of the present invention is a rotator for a limb comprising a mount connectable to the limb and having a first and second stop, ground engageable means rotatably mounted to the mount about an axis of rotation, means bearingly spacing the mount and ground engageable means apart, a projection fixedly connected to the ground engageable means and movable about the axis between the first and second stop, and spring means mounted on the mount and operable to normally urge the projection against a first stop but yieldable to allow the projection to abut the second stop as the ground engageable means rotates with the respect to the mount.

It is an object of the present invention to provide a transverse rotator for an orthotic and/or prosthetic patient.

Yet another object of the present invention is to provide a mechanical simulation of the normal anatomic transverse rotation exhibited by a human lower extremity.

Related objects and advantages of the present invention will be apparent from the following description.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a side view of a shoe with a rotator incorporating the present invention

FIG. 2 is an enlarged exploded view of the rotator 14 of FIG. 1

FIG. 3 is a side view of rotator 14 shown assembled.

FIG. 4 is the same view as FIG. 2 only showing an alternate embodiment thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

For the purposes of promoting an understanding of the principles of the invention, reference will now be made to the embodiments illustrated in the drawing and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended, such alterations and further modifications in the illustrated device, and such further applications of the principles of the invention as illustrated therein being contemplated as would normally occur to one skilled in the art to which the invention relates.

Referring now to FIG. 1, there is shown a shoe 10 having a sole 11 and heel 12. A plate 13 is fixedly mounted within sole 11 with the rotator 14 incorporated in the present invention fixedly secured thereto by conventional fastening means. FIG. 2 is an exploded view of the rotator 14 shown in FIG. 1. The various parts enclosed by bracket 14 combine into a single assembly as shown in FIG. 3. In the first embodiment of the present invention, the rotator has a mount 15 which is circular in shape with a disc 16 being integrally joined to a rim 17. A plurality of holes 18 are provided so as to allow fastening devices to extend therethrough to secure the mount to plate 13. It is understood that rotator 14 may also be secured to the bottom of an artificial support in lieu of a shoe and thus, mount 15 may also be secured to the bottom of a depending support attached to the persons body. A hole 19 is provided in the center of disc 16 to receive locking screw 26. Hole 19 is threaded to receive the threaded shank of screw 26. The head of screw 26 is received in a suitable countersunk aperture in plate 24.

Plate 24 provides the ground engageable means which is rotatably mounted to mount 15 about an axis of rotation 24' which extends centrally through plate 24 and disc 16. A standard thrust bearing 21 having roller bearings 22 rotatably mounted therein is positioned between mount 15 and plate 24 with a pair of hardened racers 20 and 23 being positioned on either side of bearing 21. Plate 24 has an upraised portion 25 with a recess 27 formed therein. A pair of slots 31A and 31B are formed in upraised portion 25 and communicate with recess 27. Recess 27 has a pair of side walls 28 and 29 which extend out radially from axis 24' forming included angle 30. Slots 31A and 31B extend arcuately about axis 24' having respectively ends 38 and 39. The upraised portion 25 is sized so as to fit centrally through racers 20 and 23 and bearing 21. Projection 33, which rises from plate 16, extends down through the racers and bearing and into recess 27. The projection 33 has a pair of side walls 34 and 35 which extend radially outward from axis 24' extending through hole 19. Sides 34 and 35 form included angle 36. With the parts assembled as shown in FIG. 3, rim 17 of mount 15 extends downwardly past the two racers and thrust bearings to fit just short of being flush with the under surface of the bottom plate 24. The bottom plate has a non-skid rubber covering 37 cemented to its under surface to ensure a firm grip to the floor.

A helical spring 32 is positioned in either slot 31A or 31B so as to normally urge one side of projection 33 against one of the side walls of recess 27. For example, if spring 32 was positioned in slot 31A, then one end of the spring would abut slot end 38 with the other end of the spring contacting wall 35 of projection 33 and urging wall 34 of projection 33 against wall 29 of recess 27. Likewise, if spring 32 was positioned in slot 31B, then the spring would urge wall 35 of projection 33 against wall 28 of recess 27.

Many variations in the present invention are contemplated and included herein. For example, FIG. 4 is the same view as FIG. 2 only showing a second embodiment of the rotator with projection 33 being positioned on plate 24 and with the upraised portion 25 and recess 27 along with slots 31A and 31B being provided on mount 15. Projection 33 could also be replaced by a series of pegs for contacting the side walls of recess 27. Likewise, the side walls 29 and 28 of recess 27 could be replaced by a series of projections or pegs to abut and limit the movement of projection 33.

The embodiment shown in FIG. 2 allows projection 33, which is fixedly connected to mount 15, to be moved about the axis of rotation between the first and second stop defined by walls 28 and 29. Spring 32 mounted on the ground engageable means 24 is operable to normally urge the projection 33 against one of the walls of recess 27 as previously described and is also yieldable to allow projection 33 to abut against the second wall as the ground engageable means rotates with respect to the mount. Walls 29 and 28 diverge and extend radially from axis 24' with slot 31A and 31B extending through the side walls of the recess. The side walls of the projection likewise diverge extending radially from axis 24' and are spaced apart by an included angle 36. Angle 36 is at least 5° less than the included angle 30. Screw 26 is removable and singularly connects the ground engageable means 24 with mount 15

so as to allow removal of the ground engageable means and replacement with a new ground engageable means having a different included angle 30. If plate 24 has a projection 33 mounted thereon, as shown in FIG. 4, in lieu of the recess formed in the upraised portion, then the ground engageable means may be removed so as to install another ground engageable means having a projection of different included angle 36. In certain cases, the included angle 36 would be at least 20° less than included angle 30 depending upon the amount of rotation desired.

The rotator disclosed herein has several main advantages. The first advantage is that friction, which is created by the body's weight pressing upon the floor through the extremity in the stance phase, is reduced to a very low value by the thrust bearings. In addition, the amount of rotation is limited with the limitations being based upon the known average magnitudes of transverse rotation which are performed by the tibia, femur and pelvis during the normal walking cycle. The rotator provides external transverse rotation for the limb while it is in the stance phase and its spring returns the rotating disc to the neutral position, i.e., assimilating anatomic internal transverse rotation, whenever the shoe is not in contact with the floor as during the swing phase. In addition, the rotator conserves the wearer's energy. It can be appreciated that as the limb contacts the ground and begins to rotate, the ground engageable means 24 will rotate with respect to mount 15 and the limb a maximum amount equal to the difference between included angles 30 and 36. As the limb is then lifted up off of the ground, the return spring will force the ground engageable means back to its normal position thereby setting the rotator for another step.

It has been determined that included angle 36 should be approximately 20° less than included angle 30 when it is desired to achieve a mean normal motion for both the tibia and femur. For purposes of standardization of manufacture of the rotators, ten degrees for each bony segment has been chosen. A rotator is secured to the bottom of each of the two limbs with each rotator having oppositely rotating ground engageable plates. Of course, the angles may be varied greatly. For example, in the case of a unilateral paralysis of the foot-ankle complex, the transverse rotator would be set for 10° of external rotation, that is, the equivalent of the anatomic external rotation of the tibia only--assuming the rest of the extremity is normal.

It will be obvious from the above description that the present invention provides a simple friction-free orthotic-prosthetic transverse rotator which has been designed to meet two major problems. First, the rotator will relieve the torsional forces upon stump tissues, and, secondly, the rotator will substitute for the loss of the thrust generated at push-off.

The invention claimed is:

1. A rotator for a limb comprising:

a mount connectable to said limb;

ground engageable means rotatably mounted to said mount about an axis of rotation, said means having a first and second stop;

bearing means spacing said mount and said ground engageable means apart;

a projection fixedly connected to said mount and movable about said axis between said first and second stop; and,

spring means mounted on said ground engageable means and operable to normally urge said projection against said first stop but yieldable to allow said projection to abut said second stop as said ground engageable means rotates with respect to said mount; and wherein:

said ground engageable means has a recess with diverging side walls extending radially from said axis spaced apart by a first included angle, said ground engageable means has a slot communicating with said recess which extends through at least one of said side walls;

said projection has diverging walls extending radially from said axis and spaced apart by a second included angle of at least 5° less than said first included angle; and,

said spring means is a helical spring positioned in said slot and normally urging one of said walls of said projection against one of said side walls of said recess.

2. The support of claim 1 wherein:
said slot extends through both of said side walls; and,
said mount encloses said bearing means and extends adjacent said ground engageable means.

3. The support of claim 2 wherein:
said slot extends arcuately about said axis.

4. The support of claim 3 and further comprising:
a first racer plate positioned between said mount and said bearing means; and,
a second racer plate positioned between said ground engageable means and said bearing means.

5. The support of claim 4 and further comprising:
a locking screw extending in the direction of said axis and removably and singularly connecting said ground engageable means and said mount together, and wherein:
said bearing means is a ring-shaped plate with thrust bearings.

6. The rotator of claim 5 wherein:
said ground engageable means is a plate with an upraised disc portion extending through said first racer plate and said bearing means;
said plate of said ground engageable means has a non-skid rubber covering mounted thereto.

7. The rotator of claim 6 wherein:
said second included angle is at least 20° less than said first included angle.

8. A rotator for a limb comprising:
a mount connectable to said limb and having a first and second stop;
ground engageable means rotatably mounted to said mount about an axis of rotation;
bearing means spacing said mount and said ground engageable means apart;
a projection fixedly connected to said ground engageable means and movable about said axis between said first and second stops;
spring means mounted on said mount and operable to normally urge said projection against said first stop but yieldable to allow said projection to abut said second stop as said ground engageable means rotates with respect to said mount; and wherein:
said mount has a recess with diverging side walls extending radially from said axis and spaced apart by a first included angle, said mount has a slot communicating with said recess which extends through

both of said side walls;
said projection has diverging walls extending radially from said axis and spaced apart by a second included angle at least 5 degrees less than said first included angle; and,
said spring means is a helical spring positioned in said slot and normally urging one of said side walls of said projection against one of said side walls of said recess.

9. A rotator for a limb comprising:
a mount connectable to said limb;
ground engageable means rotatably mounted to said mount about an axis of rotation, said means having a first and second stop;
bearing means spacing said mount and said ground engageable means apart;
a projection fixedly connected to said mount and movable about said axis between said first and second stop; and,
spring means mounted on said ground engageable means and operable to normally urge said projection against said first stop but yieldable to allow said projection to abut said second stop as said ground engageable means rotates with respect to said mount; and wherein:
said ground engageable means has a recess with diverging said walls extending radially from said axis spaced apart by a first included angle, said ground engageable means has a slot communicating with said recess which extends through at least one of said side walls;
said projection has diverging walls extending radially from said axis and spaced apart by a second included angle of at least 5 degrees less than said first included angle; and,
said spring means is a spring positioned in said slot and normally urging one of said walls of said projection against one of said side walls of said recess.

10. A rotator for a limb comprising:
a mount connectable to said limb and having a first and second stop;
ground engageable means rotatably mounted to said mount about an axis of rotation;
bearing means spacing said mount and said ground engageable means apart;
a projection fixedly connected to said ground engageable means and movable about said axis between said first and second stops;
spring means mounted on said mount and operable to normally urge said projection against said first stop but yieldable to allow said projection to abut said second stop as said ground engageable means rotates with respect to said mount; and wherein:
said mount has a recess with diverging side walls extending radially from said axis and spaced apart by a first included angle, said mount has a slot communicating with said recess which extends through both of said side walls;
said projection has diverging walls extending radially from said axis and spaced apart by a second included angle at least 5 degrees less than said first included angle; and,
said spring means is a spring positioned in said slot and normally urging one of said side walls of said projection against one of said side walls of said recess.