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(54) **APPENDAGE COVER**

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(57) **ABSTRACT**

An appendage cover (10) for at least partially covering a portion of an appendage (14) of a user to permit the appendage to slide upon a selected support surface is disclosed. The appendage cover includes an outer surface (16) of a first material, the outer surface oriented to engage the support surface when worn upon the appendage. The first material has a low coefficient of friction to permit the appendage to slide upon the support surface and to impede the adhering of the outer surface to the support surface. The appendage cover further includes an inner surface (18) of a second material, the inner surface oriented to engage the appendage. The second material has a high coefficient of friction to permit the appendage to adhere to the outer surface to impede the sliding of the appendage relative to the inner surface.

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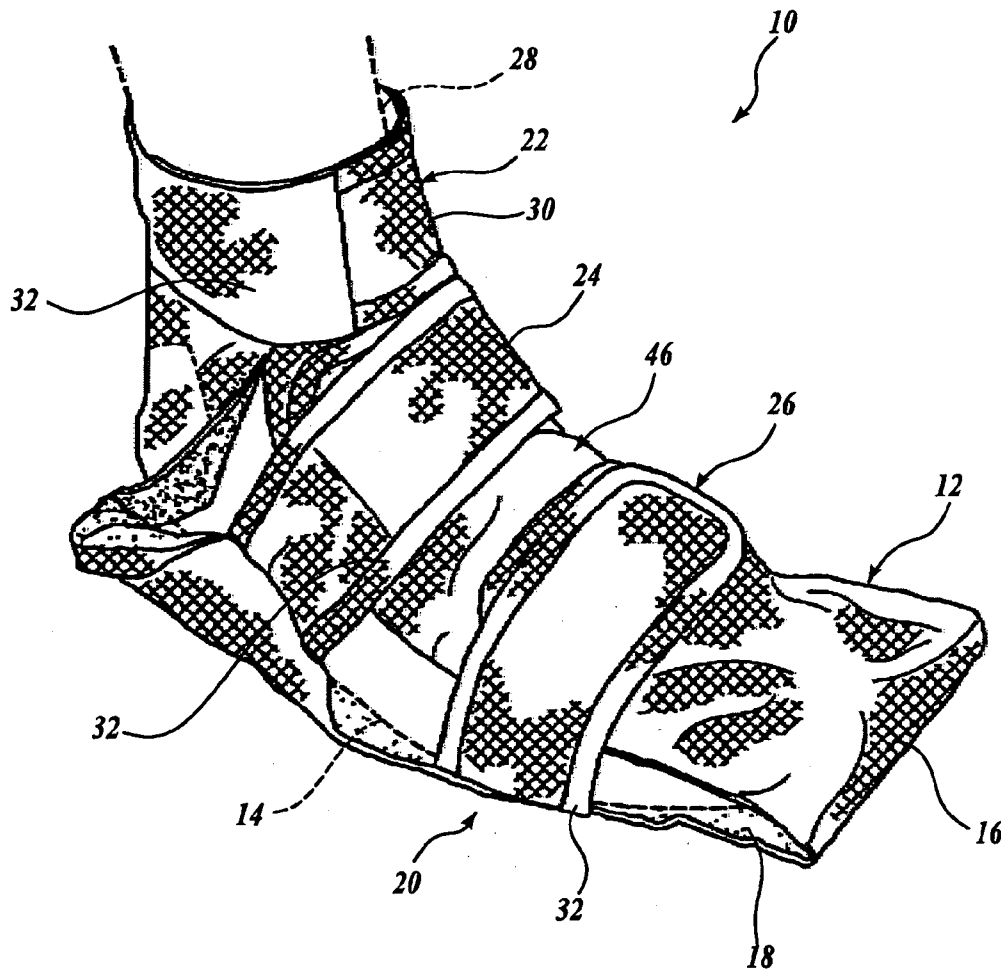
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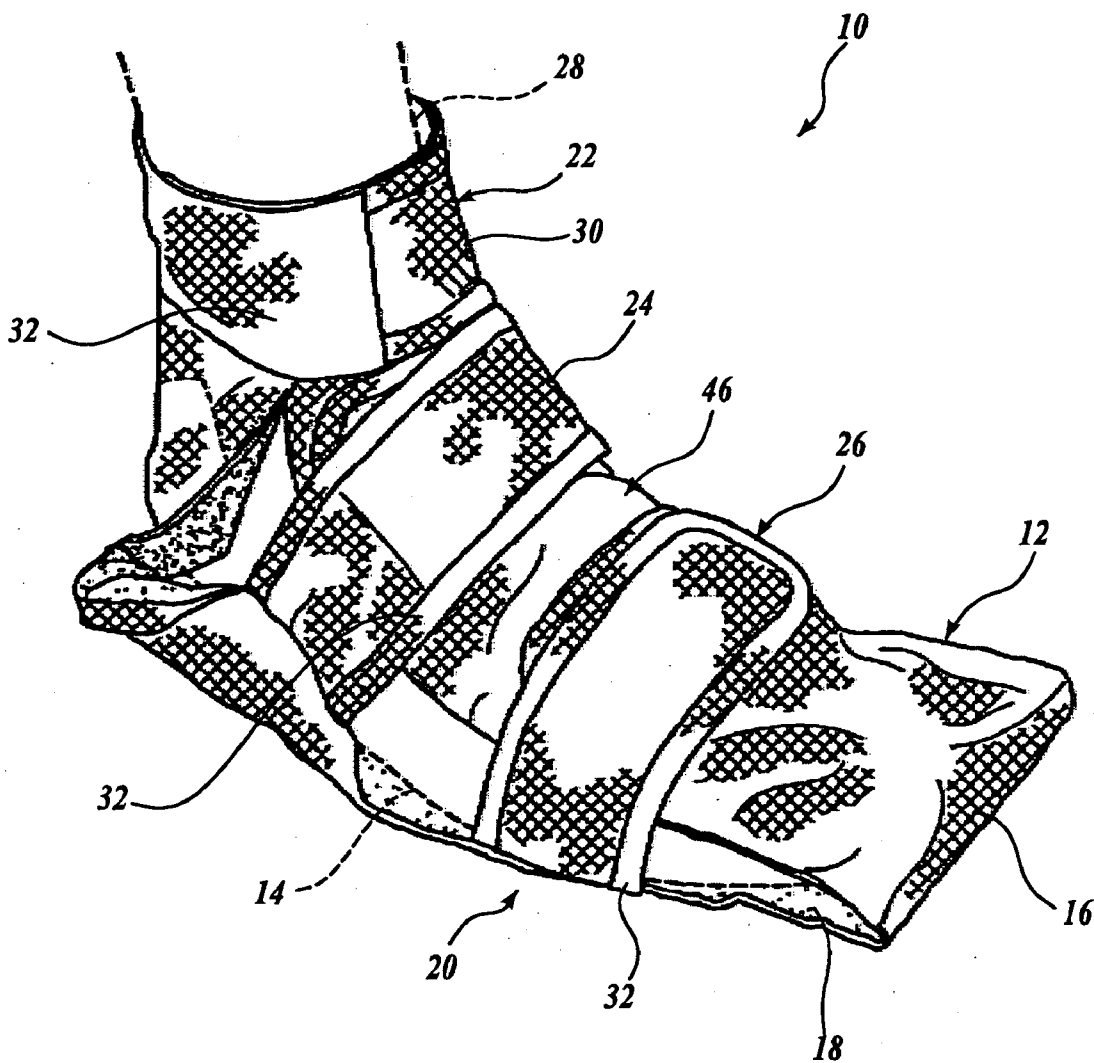
**Related U.S. Application Data**

(60) **Provisional application No. 60/463,756, filed on Apr. 16, 2003.**

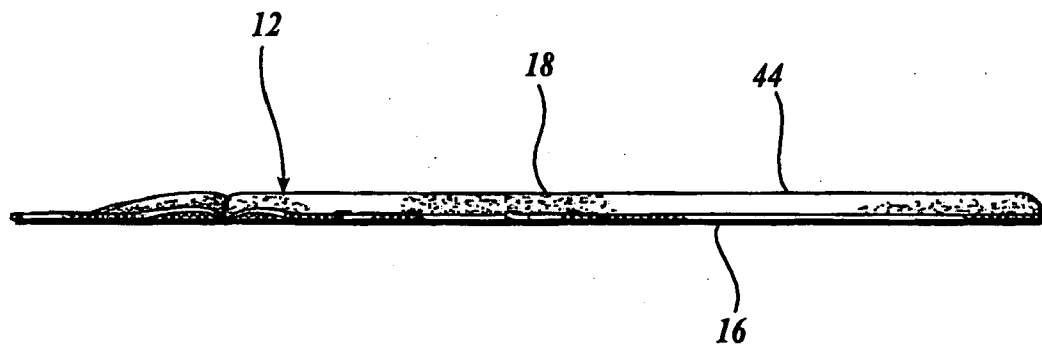
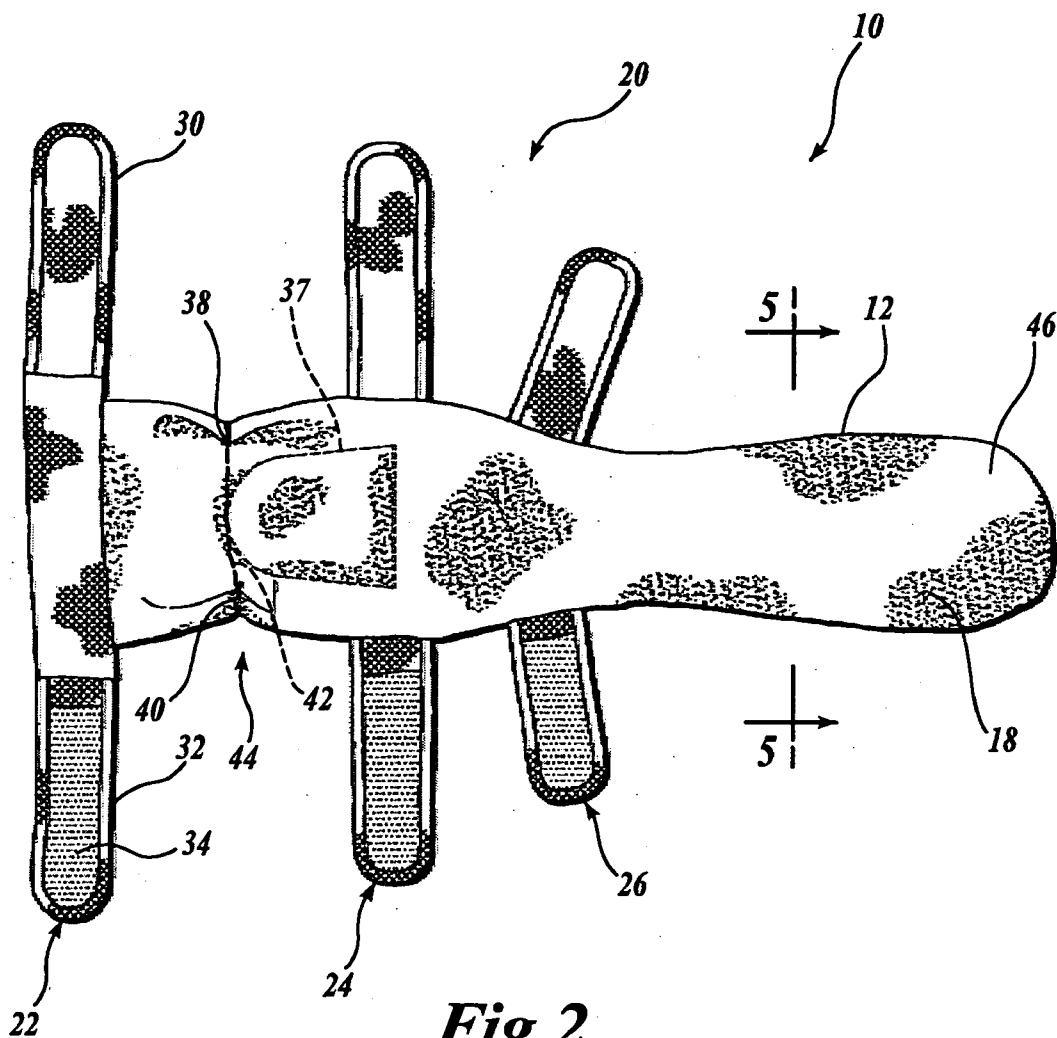
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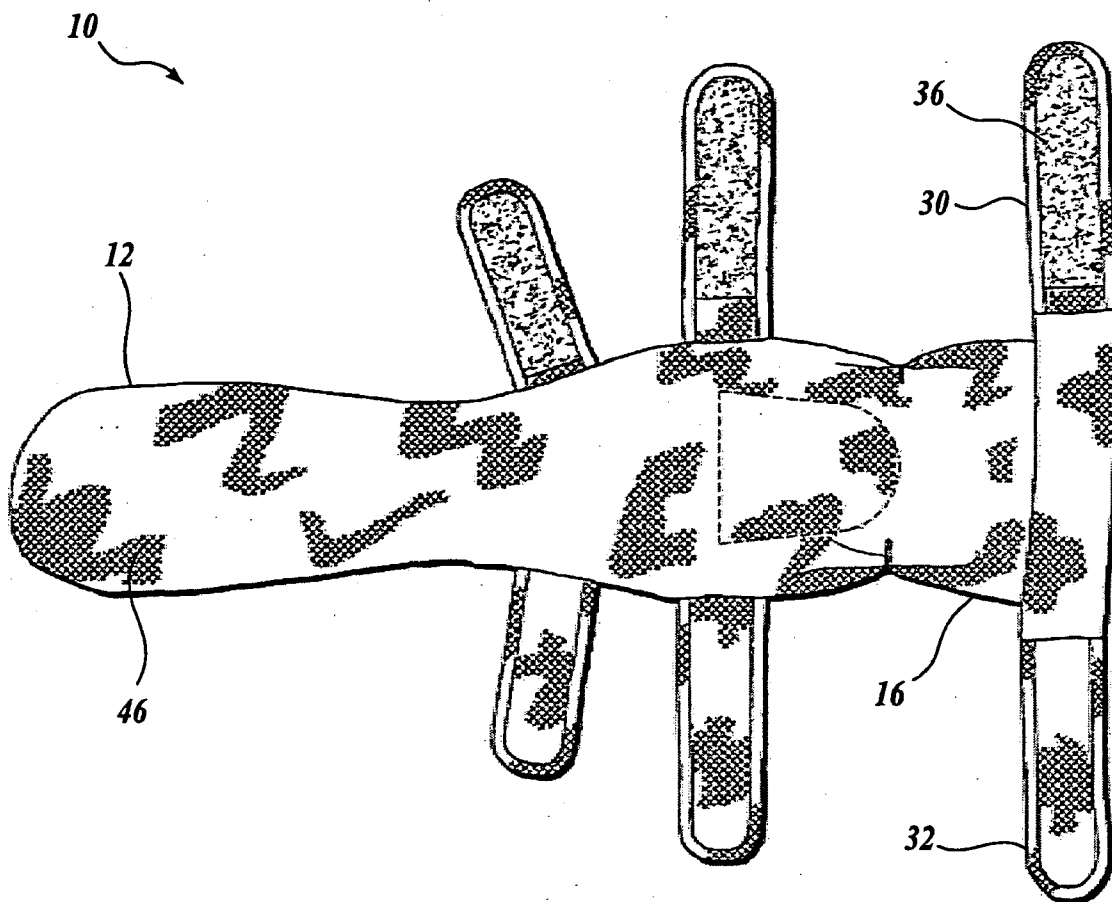
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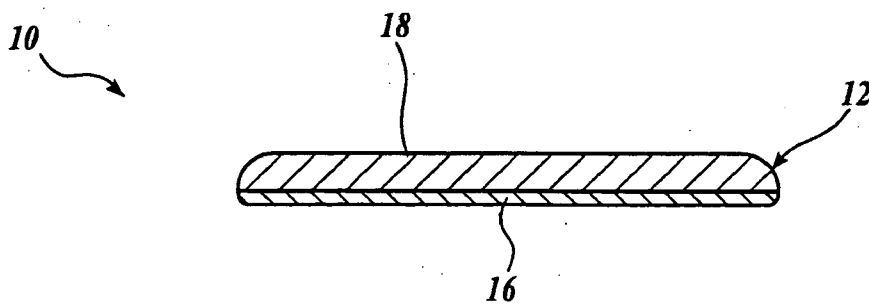


**Fig. 1.**





**Fig. 4.**



**Fig. 5.**

## APPENDAGE COVER

### CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of U.S. Provisional Patent Application No. 60/463,756 filed on Apr. 16, 2003, entitled "Appendage Cover," the disclosure of which is hereby expressly incorporated by reference.

### FIELD OF THE INVENTION

[0002] The present invention relates generally to rehabilitative devices, and more particularly to appendage covers adapted to permit the covered appendage to selectively glide upon a surface.

### BACKGROUND OF THE INVENTION

[0003] In the healthcare industry, a patient of limited mobility is often transferred from one location to another, such as from a wheelchair, bed, toilet, or car to another location. Although such an operation appears benign on the surface, it has been discovered that injuries can occur to both healthcare workers and their patients during the performance of the transfer. Potential for injury during the transfer is present in many forms, however one specific source of injury in particular has not been addressed by previously developed safety aids. More specifically, it has been found that during the transfer, a patient's foot of a weak or paralyzed leg sticks or catches on the floor, causing stress on the hip, knee, and ankle joints. As the healthcare worker continues to transfer the patient, the patient's foot remains "adhered" to the floor as the patient is rotated and moved from the wheelchair to the bed, resulting in the patient's leg becoming twisted, stepped upon, folded under the patient, etc. Adherence of the foot potentially causes injury to the patient, such as sprains, strains, and/or fractures. Additionally, the adherence of the foot upon the floor significantly increases the difficulty of the transfer, which can result in an increase in injuries to the healthcare workers. Thus, healthcare workers are subject to injury during transfer operations, especially back injuries.

[0004] It also been discovered that injuries can occur to patients while using a wheelchair, most notably when a leg of the user has lost some degree of mobility, such as a result of a stroke. For example, it has been found that during the use of the wheelchair, a patient often propels the wheelchair with the unaffected leg while either dragging the weakened leg or supporting the weakened leg with a leg rest. In the situation of the weakened leg being rested upon the floor surface, a sole of a shoe worn by the user, or other such foot covering, has a tendency to adhere or grab the floor. The user is then injured as the foot is impacted and or twisted as the wheelchair continues to move forward.

[0005] Further, during the rehabilitation of an appendage, such as a foot or a hand, it is often desirable to slide the limb along a surface during performance of a rehabilitation exercise. However, it has been discovered that the skin of the appendage or appendage cover, such as a shoe, tend to grab or stick upon the surface, resulting in excess frictional forces and a jerking motion as the skin or appendage cover grabs and releases from the surface. These excess frictional forces decrease the range of motion that the patient is able to swing the limb through, thus decreasing the effectiveness of the

exercise. Further, the resisting friction forces may be too great, potentially preventing the patient from even performing the exercise.

[0006] Thus, there exists a need for an appendage cover that permits the appendage to glide upon a variety of surfaces.

### SUMMARY OF THE INVENTION

[0007] An embodiment of an appendage cover formed in accordance with the present invention for reducing surface friction of a weak or paralyzed appendage of a person to permit the appendage to glide upon a surface is disclosed. The appendage cover includes a body portion for covering at least a portion of the appendage. The body portion includes a grip surface positioned to engage the appendage and hold the body portion stationary relative to the appendage. The body portion also includes a glide surface positioned to slide upon the surface during movement of the person. The glide surface has a predetermined coefficient of friction sufficient to enable the appendage to glide upon the surface when (1) the appendage is resting upon the surface and (2) not bearing the weight of the user and further sufficient to permit the appendage to remain immobile upon the surface when the appendage is bearing at least a portion of the weight of the user.

[0008] An alternate embodiment of an appendage cover formed in accordance with the present invention for reducing surface friction of a weak or paralyzed appendage of a person to permit the appendage to glide upon a surface is also disclosed. The appendage cover includes a body portion for covering at least a portion of the appendage. The body portion includes a grip surface positioned to engage the appendage and hold the body portion stationary relative to the appendage. The body portion further includes a glide surface positioned to slide upon the surface during movement of the appendage. The glide surface formed from a fabric of a predetermined fineness rating to enable the appendage to glide upon the surface when (1) the appendage is resting upon the surface and (2) not bearing the weight of the user and further sufficient to permit the appendage to remain immobile upon the surface when bearing at least a portion of the weight of the user.

[0009] A second alternate embodiment of a foot cover formed in accordance with the present invention for reducing surface friction of a weak or paralyzed leg of a person to permit a foot of the leg to glide upon a surface is further provided. The foot cover includes a body portion for covering at least a portion of a shoe donned by the foot. The body portion includes a grip surface positioned to engage the shoe and hold the body portion stationary relative to the shoe during use. The body portion further includes a glide surface positioned to slide upon the surface during movement of the leg, the glide surface formed from a fabric having a fineness rating of less than 400 denier.

[0010] A third alternate embodiment of an appendage cover formed in accordance with the present invention for at least partially covering a portion of an appendage of a user to permit the appendage to slide upon a selected support surface is disclosed. The appendage cover includes an outer surface oriented to engage the support surface when the appendage cover is worn upon the appendage, the outer surface having a predetermined coefficient of friction suffi-

cient to permit the appendage to slide upon the support surface and to impede the adhering of the outer surface to the support surface. The appendage cover also includes an inner surface oriented to engage the appendage, the inner surface having a selected coefficient of friction higher than the predetermined coefficient of friction to permit the inner surface to adhere to the appendage to impede the appendage from moving relative to the inner surface.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The foregoing aspects and many of the attendant advantages of this invention will become better understood by reference to the following detailed description, when taken in conjunction with the accompanying drawings, wherein:

[0012] **FIG. 1** is an isometric view of one embodiment of an appendage cover formed in accordance with the present invention, depicted worn upon a foot of a user;

[0013] **FIG. 2** is a top plan view of the appendage cover depicted in **FIG. 1**, the appendage cover depicted in a flat, laid out position;

[0014] **FIG. 3** is an elevation view of the appendage cover depicted in **FIG. 2**;

[0015] **FIG. 4** is a bottom plan view of the appendage cover depicted in **FIG. 2**; and

[0016] **FIG. 5** is a cross-sectional view of the appendage cover depicted in **FIG. 2**, the cross-sectional cut taken substantially through section 5-5 of **FIG. 2**.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0017] **FIGS. 1-5** depict an illustrated embodiment of an appendage cover **10** formed in accordance with the present invention. Although the illustrated embodiment of the present invention is described as implemented for use as a cover for a foot of a user, those skilled in the relevant art will appreciate that the disclosed appendage cover **10** is illustrative in nature and should not be construed as limited to application with the foot of a user. It should therefore be apparent that the appendage cover **10** has wide application, and may be used in any situation where reducing the coefficient of friction of a body part, such as a hand, an elbow, a portion of a limb remaining after amputation, etc., is desirable. It should also be noted that for purposes of this disclosure, terminology such as forward, aft, left, right, etc. should be construed as descriptive and not limiting.

[0018] Referring to **FIG. 1** and generally described, the appendage cover **10** reduces surface friction and thereby allows a weak or paralyzed foot **14** to glide safely with the body, helping to eliminate stress placed on the hip, knee and ankle joints. The appendage cover **10** helps to reduce the risks of fracture, sprains, strains, and surprise twists caused when the foot **14** of a patient catches or sticks to the floor. The appendage cover **10** may be used to enhance transfer ease, ambulation speed and distance, leg control, joint protection, and active muscle capability. The appendage cover **10** of the illustrated embodiment is designed to enable the caregiver easier and safer transfers, and to maximize patient mobility. The appendage cover **10** of the illustrated embodiment is durable, lightweight, portable and easy to use.

[0019] Referring to **FIGS. 1-5** and focusing on the structure of the appendage cover **10**, the appendage cover includes a flexible cover **12** adapted to substantially cover a foot **14** of a user, the flexible cover **12** removably coupled to the foot **14** by an attachment assembly **20**. The flexible cover **12** includes an outer layer **16** and an inner layer **18**. The outer layer **16** is suitably formed from a flexible material having a low coefficient of friction. The coefficient of friction is selected to permit the foot **14** of a moderate (50% to 75%) or maximum (75% to 100%) weakened leg to slide easily upon a surface, most notably flooring surfaces, without grabbing or "adhering" thereto while the foot **14** is in a non-load bearing position, i.e. a position wherein the limb bears substantially only the weight of the limb itself.

[0020] On the other hand, the coefficient of friction of the outer layer **16** is preferably not too low so as to permit the foot to bear the weight of the user without slipping out from under the user. In one embodiment, the leg is able to be angled up to about 10 degrees relative to the support surface while bearing the weight of the user before the foot slips out from under the user. In another embodiment, the leg is able to be angled up to about 15 degrees relative to the support surface and bear the weight of the user before the foot slips out from under the user. In another embodiment, the leg is able to be angled up to about 20 degrees relative to the support surface and bear the weight of the user before the foot slips out from under the user. In still another embodiment, the leg is able to be angled up to about 30 degrees relative to the support surface and bear the weight of the user before the foot slips out from under the user.

[0021] Preferably the outer layer **16** is made from a fabric, one suitable material being a nylon fabric, having a fineness rating of between about 100 denier and about 400 denier, with a preferred fineness rating of 200 denier. Although the outer layer **16** of the illustrated embodiment is described as a fabric made from a specific material, it should be apparent to those skilled in the art that the outer layer **16** may be formed from any number of materials, all of which are suitable for use with and within the spirit and scope of the present invention.

[0022] The inner layer **18** is suitably formed from a flexible material having a high coefficient of friction, the coefficient of friction selected to adhere to the foot **14** or a shoe enclosing the foot **14**, such that the appendage cover **10** grips the foot and does not slide relative to the foot **14** during use. One suitable material for the inner layer **18** is a synthetic rubber, such as DUPONTS® neoprene. Although the inner layer **18** of the illustrated embodiment is described as made from a specific material, it should be apparent to those skilled in the art that the inner layer **18** may be formed from any number of materials, all of which are suitable for use with and within the spirit and scope of the present invention.

[0023] Referring now to **FIGS. 1, 2, and 4**, the attachment assembly **20** includes an ankle attachment device **22**, a hindfoot attachment device **24**, and a midfoot attachment device **26**. The ankle attachment device **22** couples the appendage cover **10** to the ankle or leg **28** of the user. The ankle attachment device **22** of the illustrated embodiment includes a left strap **30** and a right strap **32**, each extending perpendicularly outward from a longitudinal axis of the appendage cover **10** at the aft end of the appendage cover **10**. The right strap **32** may be joined to the left strap **30** around

the leg **28** of the user through the use of a well known hook and loop fastening system. More specifically, the right strap **32** may include a portion of hook fabric **34** that engages a portion of loop fabric **36** disposed on the left strap **30**, thereby removably coupling the appendage cover to the leg **28** of the user.

[0024] The hindfoot and midfoot attachment devices **24** and **26** are substantially similar in construction and operation to the ankle attachment device **22** described above with exception to their location on the appendage cover **10**. As the name implies, the hindfoot attachment device **24** is coupled in proximity to a heel of the user, such that the left and right straps, when coupled to one another, encircle the hindfoot portion of the foot, i.e. over the astragalus and/or scaphoid bones of the foot **14**. The midfoot attachment device **26** is coupled forward of the hindfoot attachment device **24**, such that the left and right straps of the midfoot attachment device **26**, when coupled to one another, encircle the midfoot portion of the foot, i.e. over the metatarsal bones of the foot **14**.

[0025] Although the attachment assembly **20** is described as formed from straps **30** and **32** utilizing a hook and loop fastening system for coupling the straps to one another, it should be apparent to those skilled in the art that the attachment assembly **20** may utilize any number of well known fastening systems for coupling the straps to one another, such as buckles, buttons, clips, etc. Further, although the illustrated embodiment utilizes an attachment assembly **20** having straps for coupling the appendage cover **10** to the foot **14** of the user, it should be apparent to those skilled in the art that the other attachment assemblies are suitable for use with the present invention. For instance, the attachment assembly **20** may suitably include laces, zippers, elastic material, etc. for removably coupling the flexible covering **12** to the foot **14** of the user and are therefore within the spirit and scope of the present invention.

[0026] Referring to **FIG. 2**, the appendage cover **10** further includes indicia **37** to mark the preferred placement of the heel upon the appendage cover **10** when donning. The indicia **37** may be visual indicia and/or physical indicia. Moreover, the indicia **37** may be formed in any number of manners, such as by printing an outline of the preferred location of the heel upon the inner layer **18** or sewing a line of stitching in a rough outline of the periphery of a heel as an indicator of the preferred location of the heel upon the inner layer **18**.

[0027] Still referring to **FIG. 2**, the appendage cover **10** further includes a left tether and a right tether **38** and **40** respectively. The tethers **38** and **40** are formed from a loop of thread passing through the flexible cover **12** and encircling a small portion of the flexible cover **12**, "bunching up" the fabric in the location of the tethers **38** and **40**. The tethers **38** and **40** thus aid in forming a hinge **42** in the flexible cover **12**, the hinge **42** providing a preferential fold line. The hinge **42** thus aids in the folding of the rear portion of the flexible cover **12** up behind the ankle during donning of the appendage cover **10**. Further, the tethers **38** and **40** create a reduced width portion **44** of the flexible cover **12**, which aids in providing a visual indication of where the heel of the foot should be placed by providing a rounded section in the flexible cover **12** which generally matches the round shape of the heel of the foot.

[0028] Referring to **FIGS. 1 and 2**, in light of the above description of the structure of the appendage cover **10**, the operation of the appendage cover **10** will now be described. In donning the appendage, the user lays the appendage cover **10** in a flat, laid out position as depicted in **FIG. 2**, with the inner layer **18** facing the foot of the user and the outer layer **16** laying against a supporting surface, such as a floor. The user, possibly with assistance of a healthcare worker, places the heel of the foot in the location indicated by the indicia **37**, i.e. just forward of the hinge **42**. The ankle attachment device **22** is fastened around the leg **28** of the user. A tongue **46** of the appendage cover **10** is then folded back upon the foot **14** so as to cover the top of the user's foot. The hindfoot and the midfoot attachment devices **24** and **26** are then fastened around the foot **14** of the user, thereby securing the tongue **46** against the foot of the user, and removably coupling the appendage cover **10** to the foot of the user.

[0029] Once donned, the outer layer **16** provides a reduced friction surface such that the foot may be easily slid upon most surfaces, such as most floor coverings, as the weight of the user is born by the users arms, other leg, and/or the healthcare worker. The low coefficient of friction of the outer layer **16** aids healthcare personnel in transferring a patient from one location to another, such as transferring a patient from a wheelchair to a bed. More specifically, the appendage cover **10** permits transfers to be performed without the foot of the patient grabbing or adhering to the floor during the transfer, thus reducing the potential for injury to the patient and healthcare workers as described above. However, the coefficient of friction of the outer layer **16** is sufficient to permit the outer layer **16** to grip the surface when the foot is in a load bearing position and supporting a least a portion of the weight of the user so that the foot does not slip out from under the user.

[0030] Further still, the outer layer **16** facilitates the performance of rehabilitative exercises by reducing the friction forces exerted upon the foot when slid upon a surface during performance of an exercise. More specifically, the appendage cover **10** permits the foot **14** to slide upon a surface, such as a floor, during rehabilitative exercises with reduced effort, thereby increasing limb mobility during the exercise. For instance, in one exercise, a user lays upon a pad and swings their leg to the left and right in a pendulum like manner upon the pad. Due to the reduction of friction, the arc which the user is able to swing the leg through is increased, enhancing the rehabilitative quality of the exercise. In some cases, the appendage cover **10** reduces the amount of friction to a point that permits the user to slide the foot across an exercise surface wherein such movement was previously impossible without the application of the appendage cover **10**.

[0031] The low coefficient of friction of the outer layer **16**, which permits a foot **14** wearing the appendage cover **10** to slide without grabbing upon a floor, is also advantageous for a wheel chair bound person. More specifically, the appendage cover **10** permits a user to push or slide ahead a covered foot **14** in front of the wheelchair when the foot falls off of a foot support platform of the wheelchair or when a foot support platform is not used. During such use, the appendage cover **10** impedes a shoe worn by the user, or other such foot covering, from adhering to or grabbing the floor resulting in the foot being impacted and or twisted as the wheelchair continues to move forward.

[0032] Although a few examples of exemplary uses of the appendage cover **10** are described for illustrative purposes, it should be apparent to those skilled in the art that the appendage cover **10** may be used for any activity where movement of an appendage with reduced friction upon a surface is desired.

[0033] The appendage cover **10** of the illustrated embodiment is an one-size-fits-all device. It may be worn upon a large foot, a small foot, a foot covered by a shoe, sock, or other covering, or upon an uncovered foot. As should be apparent to those skilled in the art, the attachment assembly **20**, in coordination with the tongue **46**, permits the appendage cover **10** to adapt to many different sizes of feet. Although the illustrated embodiment is depicted as an one-size-fits-all device, it should be apparent to those skilled in the art that alternately, the appendage cover **10** may also be suitably formed in any number of sizes, each size selected to correspond to a selected size of a foot.

[0034] Further still, although the appendage cover **10** of the illustrated embodiment is described as formed for covering a foot of a user, it should be apparent to those skilled in the art that the appendage cover **10** may alternately be formed to be donned upon alternate areas or appendages of the body. For instance, the appendage cover **10** may be alternately formed to cover a hand, wrist, elbow, head, back, ankle, calf, knee, thigh, leg, back, etc. of a user. It should be apparent to those skilled in the art that the size, shape, orientation, etc. of the flexible cover and attachment assembly may be varied from the illustrated embodiment to better accommodate the coupling of the appendage cover **10** to the desired portion of the body. Further, for the purposes of this detailed description, the term appendage includes any articles of clothing or other objects worn by the appendage such as a sock or a shoe covering a foot.

[0035] Further still, although the illustrated embodiment is depicted as worn upon the foot of the user, it should be apparent that the illustrated appendage cover **10** may be donned upon alternate areas of the user, such as about the hand, wrist, elbow, etc. of the user without modification.

[0036] While the illustrated embodiments of the invention have been illustrated and described, it will be appreciated that various changes can be made therein without departing from the spirit and scope of the invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An appendage cover for gliding upon a surface, the appendage cover comprising:

a body portion for covering at least a portion of the appendage, the body portion including;

(a) a grip surface positioned to engage the appendage and hold the body portion stationary relative to the appendage; and

(b) a glide surface positioned to slide upon the surface during movement of a user, the glide surface having a predetermined coefficient of friction sufficient to enable the appendage to glide upon the surface when (1) the appendage is resting upon the surface and (2) not bearing a weight of the user and further sufficient to permit the appendage to remain immobile upon

the surface when the appendage is bearing at least a portion of the weight of the user.

2. The appendage cover of claim 1, wherein the predetermined coefficient of friction is sufficient to permit a user to glide the appendage upon the surface unassisted when the appendage is not bearing the weight of the user and when the appendage is weakened more than about 50%.

3. The appendage cover of claim 2, wherein the predetermined coefficient of friction is sufficient to permit a user to glide the appendage upon the surface unassisted when the appendage is not bearing the weight of the user and when the appendage is weakened more than about 75%.

4. The appendage cover according to claims 2 or 3, wherein the predetermined coefficient of friction is sufficient to permit the appendage to bear the weight of the user at an angle of up to about 15 degrees relative to the support surface before slipping out from under the user to facilitate the user at least partially supporting their weight during a transfer operation.

5. The appendage cover of claim 3, wherein the glide surface is formed from nylon.

6. The appendage cover of claim 1, wherein the body portion is adapted to cover a foot of the user, the body portion having a tongue that folds up from a front of the user's foot over a top of the foot.

7. The appendage cover of claim 6, wherein the body portion includes a plurality of straps for coupling the body portion to the foot of the user.

8. The appendage cover of claim 1, wherein the grip surface is formed from neoprene rubber.

9. An appendage cover for reducing surface friction of an appendage of a user to permit the appendage to glide upon a surface, the appendage cover comprising:

a body portion for covering at least a portion of the appendage, the body portion including;

(a) a grip surface positioned to engage the appendage and hold the body portion stationary relative to the appendage; and

(b) a glide surface positioned to slide upon the surface during movement of the appendage, the glide surface formed from a fabric of a predetermined fineness rating to enable the appendage to glide upon the surface when the appendage is resting upon the surface and further sufficient to permit the appendage to remain immobile upon the surface when bearing at least a portion of the weight of the user.

10. The appendage cover of claim 9, wherein the fineness rating is less than about 400 denier.

11. The appendage cover of claim 9, wherein the fineness rating is between about 100 denier and about 300 denier.

12. The appendage cover of claim 11, wherein the fineness rating is between about 150 denier and about 250 denier.

13. The appendage cover of claim 11, wherein the glide surface is formed from a nylon fabric.

14. The appendage cover of claim 9, wherein the body portion is adapted to cover a foot of the user, the body portion having a tongue that folds up from the front of the user's foot over the top of the foot.

15. The appendage cover of claim 9, wherein the body portion includes a plurality of straps for coupling the body portion to the foot of the user.



16. The appendage cover of claim 9, wherein the grip surface is formed from neoprene rubber.

17. A foot cover for reducing surface friction of a weak or paralyzed leg of a person to permit a foot of the leg to glide upon a surface, the foot cover comprising:

- (a) a body portion for covering at least a portion of a shoe donned by the foot, the body portion including;
  - (i) a grip surface positioned to engage the shoe and hold the body portion stationary relative to the shoe during use; and
  - (ii) a glide surface positioned to slide upon the surface during movement of the leg, the glide surface formed from a fabric having a fineness rating of less than 400 denier.

18. The appendage cover of claim 17, wherein the fineness rating is between about 100 denier and about 300 denier.

19. The appendage cover of claim 17, wherein the fineness rating is between about 150 denier and about 250 denier.

20. The appendage cover of claim 19, wherein the glide surface is formed from a nylon fabric.

21. The appendage cover of claim 17, wherein the body portion is adapted to cover a foot of the user, the body portion having a tongue that fold up from the front of the user's foot over the top of the foot.

22. The appendage cover of claim 17, wherein the body portion includes a plurality of straps for coupling the body portion to the foot of the user.

23. The appendage cover of claim 17, wherein the grip surface is formed from neoprene rubber.

24. An appendage cover for at least partially covering a portion of an appendage of a user to permit the appendage to slide upon a selected support surface, the appendage cover comprising:

- (a) an outer surface oriented to engage the support surface when the appendage cover is worn upon the appendage, the outer surface having a predetermined coefficient of friction sufficient to permit the appendage to slide upon the support surface and to impede the adhering of the outer surface to the support surface; and
- (b) an inner surface oriented to engage the appendage, the inner surface having a selected coefficient of friction higher than the predetermined coefficient of friction to permit the inner surface to adhere to the appendage to impede the appendage from moving relative to the inner surface.

25. The appendage cover of claim 24, wherein the predetermined coefficient of friction is sufficient to permit the appendage to slide upon the support surface when the appendage is not substantially bearing the weight of the user but impede the sliding of the appendage upon the support surface when the appendage is bearing a substantial weight of the user.

26. The appendage cover of claim 24, wherein the outer surface is formed from a fabric having a fineness rating of less than about 400 denier.

27. The appendage cover of claim 24, wherein the outer surface is formed from a fabric having a fineness rating of between about 100 denier and about 300 denier.

28. The appendage cover of claim 24, wherein the appendage cover is shaped to cover a foot of the user, the appendage cover having a surface area greater than a surface area of a bottom of the user's foot such that the appendage cover may wrap around the foot to cover at least a portion of a top of the foot of the user.

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