July 23, 1968 E. J. KANDEL 3,393,407

ARTIFICIAL LIMB WITH END-BEARING SOCKET AND METHOD OF MAKING

Filed Dec. 16, 1965

FIG. 1

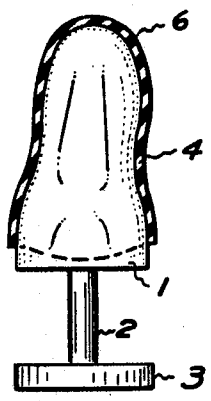


FIG. 2

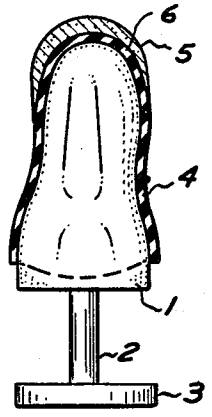


FIG. 3

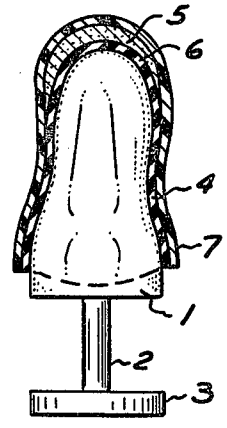


FIG. 4

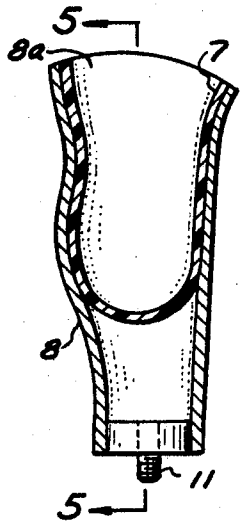


FIG. 5

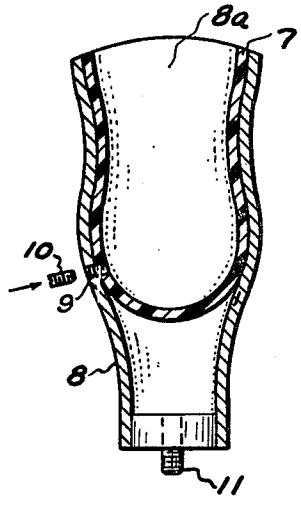


FIG. 6

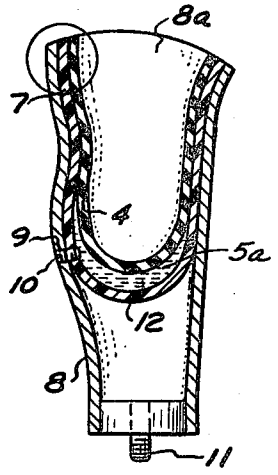
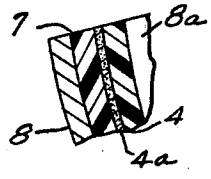


FIG. 7



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ARTIFICIAL LIMB WITH END-BEARING SOCKET AND METHOD OF MAKING

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6 Claims. (Cl. 3—20)

ABSTRACT OF THE DISCLOSURE

A prosthesis for an amputated limb constructed by making a cast of the stump of the amputated limb, coating a predetermined area of the cast with a first material suitable to form a liner to receive said stump and conforming to the contours thereof, applying a removable material to said liner in the area immediately adjacent to the weight bearing area, applying a coating of a second material to a predetermined thickness over the liner and the filler, removing the cast from the liner, removing the liner from the shell, and extracting the filler from the shell, and then reinserting the liner into the shell and applying the assembled shell and liner to an artificial limb, so that the absence of the filler leaves a chamber between the liner and the shell into which the liner may distend under pressure of use and providing means to fill said chamber with fluid.

This invention relates to improvements in prostheses for amupated legs and particularly to prostheses designed to afford bearing surface for the bottom areas of a stump of an amputated leg.

Due to the sensitivity of the bottom areas of amputated legs, support to said bottom areas has in the past been deliberately minimized or omitted. Rather, past prosthetic devices have been designed to afford support to the lateral faces of a stump, and to some extent beneath the patella, or knee-cap.

An object of this invention is to provide an artificial leg with an upwardly opening socket, and to further provide a liner of resilient material to adhere to the wall of such socket, such liner being predeterminedly proportioned to leave a chamber at the bottom of the socket, into which chamber the liner may distend under pressure from the bottom of a stump.

A further object is to form in the artificial leg a hole opening into said chamber and to inject a liquid into said chamber to distribute said pressure throughout the liquid, and to provide means to close said opening to resist escape therethrough of said liquid.

Still another object is to provide a method for the construction of said liner, and of a socket, upon a cast or model of a stump, and for assembly of said elements with an artificial leg to constitute a completed prosthesis.

These and various other objects are attained by the construction hereinafter described, and illustrated in the accompanying drawing, wherein:

FIG. 1 is a front elevational view in section, showing a cast of a stump supported in inverted position for construction of a liner.

FIG. 2 is a front elevational view similar to FIG. 1 showing the addition to the liner of a filler material, the eventual removal of which leaves said chamber.

FIG. 3 is a front elevational view in section similar to FIGS. 1 and 2, showing application of material intended to harden and form a rigid shell about the liner and filler.

FIG. 4 is a side elevational view in section showing the shell inserted within an artificial leg, with the cast, liner, and filler removed.

FIG. 5 is a rear elevational view in section, on line 5—5 of FIG. 4, showing the assembled shell and leg, with a hole through which liquid may be injected.

FIG. 6 is a rear elevational view, similar to FIG. 5, but showing the liner inserted in the shell to leave a liquid-filled chamber.

FIG. 7 is a view approximately encompassed by the circle in FIG. 6, and portrayed on a substantially larger scale to illustrate an adhesive employed in the construction.

In these views the reference numeral **1** designates a cast or model of the stump of an amputated leg. Said cast is supported, in inverted position by a rod **2**, having an end portion imbedded therein. The other end portion is mounted in a block **3**, on which the assembled device may rest. In FIG. 1, a coating of material, forming a liner, such as room-temperature vulcanizing rubber has been applied in viscous form to the cast **1**. Then a material, **5**, such as modeling clay, is applied (FIG. 2) to that external surface area of the liner which corresponds to the interior surface area which will ultimately be engaged by the bottom surfaces of a stump. The general area of said external and internal surface is indicated by reference character **6**.

In FIG. 3, a coating of plastic, which may be reinforced with a layer of fibre glass screening or the like has been applied. Such plastic is applied in viscous form and sets into a hardened form to constitute a rigid shell **7**.

In FIG. 4, the cast has been removed, as has the liner **4**. The filler **5** is cleaned out of the shell **7**, and said shell is rigidly assembled in the upper portion of an artificial limb **8** to form an upwardly opening socket **8***a*. A suitable adhesive material or the like may be used to cement together the contacting surfaces of the liner **7** and limb **8** to form a rigid assembly. Said assembly is then drilled and tapped as at **9**, to receive a set screw **10**, or the like, as seen in FIG. 5.

The assembled prosthesis is illustrated in section in FIG. 6, and is complete except for a foot, which may be attached to threaded stud **11** protruding from the bottom of the device. As assembled, between the bottom of the liner **4** and the shell **7**, a chamber, **5***a*, is formed in the area formerly occupied by the filler **5**.

A liquid **12** is injected into the chamber **5***a* through the hole **9**, which is then closed with the set screw **10** to resist escape of the liquid. Such liquid is preferably of a type which will not freeze in cold weather: oils have been found quite satisfactory.

Pressure of a stump upon the bottom of the liner is distributed throughout the liquid, some of which is displaced upwardly to afford resistance over the entire area of the liner which is exposed to the chamber. It is desirable to use an adhesive **4***a* to seal the engaging surfaces of the liner and the shell together to resist upward escape of liquid. A coating of room temperature vulcanizing rubber applied lightly to the interior surface of the shell and the exterior surface of the liner, serve very well to cause the mutual adherence of such surfaces.

The described prosthesis has been tested by the inventor, and found to afford a comfortable freedom of action which prior devices are unable to provide. It is believed that the provision of the liquid filled chamber to distribute pressure allows the use of a fully end-bearing prosthesis, and is inventive.

What I claim is:

1. A method for making a prosthesis for an amputated leg, such method including,

making a cast, or model, of which the outer surface approximates the contours of the portion of a limb to receive the prosthesis,

removably applying to said cast a coating of predetermined thickness, of a first material, applicable in

viscous form and which material progressively sets into resilient, cohesive form, to constitute a liner,

affording a predetermined period of time for the first material to set,

applying to said liner a filler for subsequent removal therefrom,

applying to said liner and filler a coating of predetermined thickness, of a second material, applicable in viscous form, and which material progressively sets into hardened form to constitute a shell,

removing said cast from the liner, the liner from the shell, and extracting the filler from said shell,

reinserting the liner into the shell to resume its original relationship to the shell, and applying the assembled shell and liner to an artificial limb, whereby the absence of said filler leaves a chamber into which the proximate portion of the liner may distend under pressure of use.

2. In the method as set forth in claim 1,

the further step of filling said chamber with a desired quantity of liquid to distribute such pressure throughout said liquid.

3. In a method as set forth in claim 1,

the further steps of applying a sealing material between the liner and the shell contacting surfaces to form a liquid tight seal,

forming a hole through the artificial limb and shell to open into said chamber,

injecting a desired quantity of liquid into said chamber to distribute such presure throughout the liquid, and sealing said hole to resist escape of the liquid.

4. In a prosthesis for the stump of an amputated leg, including an artificial limb having a hollow upper portion formed by a first sidewall,

a shell received in and upwardly opening in said artificial limb, and having a sidewall in substantially continuous abutting contact with said first sidewall, and having a bottom wall,

a liner of resilient material received in said shell, said liner having an inner surface contoured to mate with the contours of a stump, and said liner having a third sidewall substantially in continuous abutting contact with said second sidewall, and having a bottom wall, said liner being predeterminedly proportioned to leave a chamber between the bottom wall of the shell, and the bottom wall of said liner, into which chamber the lower portion of said liner may distend under pressure of use,

a quantity of liquid occupying said chamber to distribute such pressure throughout said liquid,

whereby the continuous abutting contact of said sidewalls affords resistance to movement of a stump within said liner.

5. In a prosthesis as set forth in claim 4.

a hole formed through said walls and opening into said chamber for admission of liquid to said chamber and means to seal said hole to resist escape of said liquid through said hole.

6. In a prosthesis as set form in claim 5,

means to effect a liquid seal between the contacting faces to said lines and said socket to resist escape of said liquid upwardly from said chamber.

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