L. F. GREENING.
ARTIFICIAL LIMB AND METHOD OF FORMING SAME.
APPLICATION FILED APR. 2, 1921.

1,436,875.

Fig. 1

Fig. 2

Fig. 6

Fig. 7

Fig. 8

Fig. 15

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by A. L. Johnson
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Inventor,
Leo F. Greening
by A. F. Johnson
his Attorney.
To all whom it may concern:

Be it known that I, Leo F. Greening, a citizen of the United States, residing at St. Paul, in the county of Ramsey and State of Minnesota, have invented certain new and useful Improvements in Artificial Limbs and Methods of Forming Same, of which the following is a specification.

My invention relates to artificial limbs, and has for its object, the manufacture of artificial limbs, the hollow members of which are made of raw hide of the larger and adult animals, such as the ox, bull, buffalo, and others, I having discovered that certain natural properties and characteristics of, what are termed, by leather experts, as inferior hides, are peculiarly adapted to the making of a strong, well-proportioned, durable and light limb member which is easily fabricated and is of attractive appearance.

A further object of my invention is the provision of novel means for forming the hollow member over the model whereby the irregular surfaces of the latter, such as the rounded protuberance of the fibula at the ankle and the deep cavity between it and the heel bone may be closely conformed to, without weakening the fibre structure of the hide.

Shell members of artificial limbs are now commonly made of fiber, which is an artificial fabric formed by chemically treated cotton and linen cloth or other fibrous material. This fiber is hard and tough, and is rolled, in the process of manufacture, into sheets of uniform thickness. However, in the process of forming a hollow limb member the fiber must be soaked in water for a considerable period of time (three or four days) to render it soft and pliable. The softened fiber is now progressively wrapped around the model of the limb and held tightly thereagainst by means of a rope wound spirally, under tension around the outside of the fiber. The fiber thus bound, is permitted to dry and harden, and the rope is then removed, the latter leaving its deep impress in the surface of the fiber, resulting in arcuate bottomed circumferential grooves throughout the length of the limb member (see Fig. 12) leaving sharp ridges between them. While I do not know how this fiber is made, I have used same, and found, that it is made in layers, and when thoroughly soaked, will peel off after the manner of pasteboard. In finishing the outside of the shell, the sharp ridges formed by the rope, are cut away, to render the surface smooth, thereby severing several of the outer layers of fiber and seriously weakening the shell, the outer layers being relatively the most important, as to strength. The most serious weakening, however, occurs in the region just above the ankle joint, because of its relative small diameter, which will be hereinafter explained.

An object of my invention is to obviate all the difficulties and disadvantages mentioned in the foregoing, especially the feature of being limited to a uniform thickness of material to start with, and of seriously disrupting or breaking up the fiber formation of the material, I having found, that even though, when the fiber is crowded into a deep cavity and permitted to dry it appears thicker than the original fiber board, the fibrous structure has been rent and thereby rendered less strong than the fiber board.

To this end my invention consists in so adapting the natural growth formation of a hide, relative to its natural varying thicknesses and its characteristic varying elasticity, to the natural requirements of strength, in an artificial limb, from the ankle to the knee, and in the method of shaping said hide to form a shell limb member.

In the drawings,

Figure 1 is a side view of an artificial limb embodying my invention.

Figure 2 is a front view of same.

Figure 3 is a side view of a leg model showing a hide clamped thereon by my improved method.

Figure 4 is a fragmentary perspective view of a leg model showing a hide partially clamped thereon.

Figure 5 is a perspective view of my improved clamp.

Figure 6 is a section on line 6—6 of Figure 2.

Figure 7 is a section on line 7—7 of Figure 1.

Figure 8 is an end view of the lower end of Figure 1.

Figure 9 is a side view of a section of a leg model, showing my improved clamps positioned thereon.

Figure 10 is a similar view showing how saturated artificial fiber wrinkles when forced around a concave surface.

UNITED STATES PATENT OFFICE.

LEO F. GREENING, OF ST. PAUL, MINNESOTA.

ARTIFICIAL LIMB AND METHOD OF FORMING SAME.

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Figure 11 is a front view of the hinge connection connecting the shell member with the foot member, not shown. Figure 12 represents a portion of dried artificial fiber as it appears when the rope has been removed.

Figure 13 is a sectional view taken on a line cutting transversely through the seam of the shell member.

Figure 14 is a plan view of the blank form of the hide before being applied to the leg model, and Figure 15 is a plan view of a hide showing the cutting lines defining the bends of butt, and the shoulder portion.

In the drawings (Fig. 15) A designates a hide, the lines a, b, and c serving to divide it into the bends d of the butt, the shoulders e and the bellies f. As is well known, the thickness of hides is found about three to five inches from the line of the spine and extends from the rear of the butt to the shoulder, and increases in thickness toward the cheeks. The thickness falls off slightly toward the line of the spine, decreases gradually toward the belly, so that hides will vary from five sixteenths near the spine, to three sixteenths at the outer long edge of the butt. I have taken advantage of this variation in thickness, whereby I am enabled to construct an artificial hollow limb of raw hide, gradually reducing in thickness toward the knee, in what, I term, an ideal proportion, both as to strength and weight.

An object of the invention is to use such parts of a hide as will afford increased thickness at the ankle and parts adjacent above it and gradually reduce in thickness toward the knee, so that no material cutting or skiving of the surface is necessary except to render it smooth. By so doing, I secure a hide having practically the full strength of the natural hide in its dried form, the natural fiber structure thereof not being interfered with. In this connection, the fact should be taken into account that the connective tissue fibres are the least compact in the central part of the corium, (part of the skin used for leather) and become much more closely interwoven as the hair side of the hide is approached. Obviously, if it were necessary to deeply skive the outer surface of the shell, the fiber structure would be weakened as the center of the corium is approached. Further, the lines of stretch and tightness, shown by the arrows g and h respectively (Fig. 15) are so positioned in my improved shell, as to render the forming of same, in its manufacture, easy and advantageous. My improved artificial leg member comprises a shell B formed in the rear with a longitudinal seam 1, preferably of the overlapping type (Fig. 13) wherein the adjacent edges 2 are skived to form a thin edge which latter overlap each other and secured together by silver rivets 3. In the main views I have shown an ordinary butt joint, joined together preferably, by a strip of raw hide 4 on the outside and a metallic strip 5 on the inside suitably riveted together by the silver rivets 6.

In Figures 2, 7 and 8, designate respectively the outside ankle portions of the shell, the latter having semi-circular opposite notches 9, laterally in horizontal alignment and adapted to receive the tubular pintle casing 10 (Fig. 11) of the hinge C. Extending radially from the casing are the threaded bolts 11 which latter are projected through the filling block 12 and firmly bolted therein, said block closely fitted into the hollow of the ankle portion of the shell. Depending from the pintle 13 rotateable within the tubular casing, is the bolt 14, the latter extending through the circumferentially disposed slotted hole 15, to enable it to swing. The bolt 14 carries a foot member not shown. The block is suitably fastened as by non-corrosive screws, in the shell and forms a strong durable and light weight anchor for the foot member. In Figure 14, D represents, what may be termed the blank or pattern of the shell, or in other words, the hide in flattened out position.

In Figure 15, are shown four patterns, positioned at selected places on the hide, the edges 16 thereof representing the lower edge of the ankle portion of the shell lying over the thick part of the hide adjacent to and facing the line of spine k—l. The upper edges 17 of the shells lie adjacent the outer border of the butt a, at which point the hide is much reduced in thickness. It will be noted, that the lines of tightness l (indicating the direction in which the hide will stretch the least) lie transversely of blank pattern, while the lines of stretch traverse the latter longitudinally. Thus, by cutting the blanks in the manner described I secure a thick ankle and a thin calf portion, and at the same time, the lines of tightness run circumferentially, while the lines of stretch are directed longitudinally. As the walls of the shell are at all times in compression vertically, and in tension circumferentially, it will be noted that the yielding lines of tightness resist the tendency of the web or effect of the stump of the wearer to split the shell.

My improved method of forming the shell, may be described as follows. In Figures 3 and 4 E designates a model, preferably made of wood, and adapted to be held, between the lathe centers F to facilitate the application of the hide D, it being understood that the latter is an ordinary de-haired, untanned skin which has been subjected to a suitable process such as a lye bath to remove all fats. Preparatory to
clamping the hide around the model, it is soaked in water, until saturated, causing it to swell to almost twice its original thickness, and assume a soft pliable rubber-like consistency, best indicated in Fig. 4. In this state, it is wrapped around the model, and firmly held pressed thereagainst by a plurality of my improved clamps G. The clamps consist of a relatively wide band 17, preferably made of strong flexible material such as felt leather and a soft pliable metallic lining 18, secured at wide intervals to the band, by means of suitable rivets 19. Riveted firmly to the leather at the free ends thereof are the opposite outstanding lugs 20, having radially disposed slotted bolt holes 21, adapted to receive clamping bolts 22. The clamping rings are of various diameters and shapes, so as to closely conform, when progressively assembled in contiguous relation on the hide overlying the model, to the surface contour thereof. In Fig. 4 one of the clamps is shown positioned, there still being a slight space between the lugs to permit of further adjustment should it be required. As the band is drawn taut, the pliability of the lead lining and the elasticity of the leather will yield to the pull of the clamping bolt, until the lining conforms closely to the convex surfaces over which it lies. Obviously, any concavities, or depressions underlying the lining, will not be conformed to. At such places the band is firmly struck with a mallet (Fig. 9) whereby to drive the lead lining into the cavities and into closer conformity over abruptly rounded surfaces as at the ankles. As the clamps are successively positioned, the swollen hide may be compressed to any degree desired without danger of fracturing the connective tissue structure, because the lines of stretch run longitudinally, as stated in the foregoing.

In Figure 10 is shown, how the ordinary artificial fiber board 2 wrinkles, when it is crowded over a concave surface, the wrinkles in the dried article being deep and prominent. As the tops of these wrinkles must be shaved off, to render the surface smooth, the ankle and its adjacent parts are seriously weakened, though these parts are subjected to greater strain than any other part of the limb. As shown in Fig. 3, the blank D is cut somewhat longer to permit the end clamps to grip properly. After a considerable period of drying the clamps are removed, and the shell is pried apart at the seam and the model removed.

I claim:
1. An artificial lower limb comprising a leg shaped hollow shell formed from a blank of raw hide of predetermined shape, said blank being cut from a raw hide in a manner to bring the longitudinal axis of the shell forming portion thereof at right angles to the line of the spine and the ankle forming portion thereof adjacent said line.
2. An artificial lower limb, comprising a leg shaped hollow shell made of raw hide said hide having its natural gradually decreasing thickness, the leg shaped shell being constructed to increase in thickness from the knee downwards to the ankle end thereof.
3. An artificial lower limb comprising a leg shaped hollow open ended shell made of raw hide, said hide having its natural gradually decreasing thickness, the wall of said shell increasing in thickness from its ankle end upwards, and being formed from the hide in a manner to bring the lines of tightness thereof, into transverse relation to the longitudinal axis of the shell.

In testimony whereof I affix my signature in presence of a witness:

LEO F. GREENING.

Witness:
GEORGE VOELKER.