ARTIFICIAL LIMB HAVING ADJUSTABLE PARTS

FIG. 1.

FIG. 2.

FIG. 3.
ABSTRACT OF THE DISCLOSURE

An artificial limb having a relatively adjustable thigh section, a knee section, a shin section and a foot section, which are so assembled as to permit fitting, alignment and adjustment for each patient without having to customize each limb particularly for each patient; the knee section having a knee unit embodying a universally adjustable cup adapter to receive a thigh socket therein, and having access openings for adjusting a knee action device within the knee unit; the shin section being of hollow shell-like construction and initially so shaped that by a simple cutting operation of an upper edge portion of the section, it can be adapted for either right or left limb assembly, a plurality of prepositioned holes being provided to permit mounting of a variety of available swing phase control devices therein and for convenient access to adjusting means therefrom, and further having a tubular extension which is readily and easily varied as to length, and which provides a mounting for the foot section such that the angular relation of the elongate axis of the foot section can be varied as required to provide "toe-in" or "toe-out."

BACKGROUND OF THE INVENTION

The present invention relates to the field of artificial body members, particularly legs or limbs. Therefore, artificial limbs or legs have embodied structures which in the case of each patient necessitated that the parts be substantially "custom made," and as a rule required numerous fittings and alterations, all of which took a relatively long time and a great deal of patience. The ultimate cost was thus materially increased and such artificial members became quite expensive.

Further, right and left assemblies had to be individually fabricated and fitted. That is to say, there was no standardized structure which might be readily adapted and adjusted so that it could be used either for a right assembly or a left assembly, nor were the parts so arranged as to enable the prosthetist to align and adjust the different sections in a manner to best satisfy the individual requirements of a particular patient.

Moreover, the prior structures were such as to place limitations upon the different types of materials which might be used in the construction of certain of the sections.

In the main, each leg or limb was designed for use with certain types of auxiliary devices. For example, it was not possible in the available structures to quickly and readily install and test different types and makes of hydraulic swing phase controls, with a view to ascertaining the one which best suited the requirements of the particular patient. One reason for this was that such devices embodied a variety of structures and contained control elements which were positioned at different locations on the device. Accordingly when the device was installed, the adjusting element was inaccessible for making the required adjustments.

In the present invention, the above problems have been solved by providing a unique arrangement of parts which are easily modified or changed, where necessary, for right or left assembly use, which provides ready accessibility to the parts which must be adjusted for proper alignment, proper length, foot toe-in or toe-out and the like, and which are arranged for operative use, without making material changes, with a number of different types of swing phase control devices, and when one of such devices is installed its adjustment control will be easily accessible.

SUMMARY OF THE INVENTION

The present invention relates generally to artificial legs or limbs, and is more particularly concerned with an assembly having standard adjustable parts which will permit its universal use, and which is of unique design that will accommodate a variety of action controlling devices.

Having in mind the inherent disadvantages of the prior art devices as previously explained, it is one object of the present invention to provide an artificial leg or limb structure in which the thigh section, knee section, shin section and foot section are so fabricated and interconnected as to provide a device having substantially universal use in meeting the varied requirements of different patients.

A further object is to provide a knee section having a unique knee member with a universally adjustable mounted socket adapter for receiving a thigh socket, thus permitting the socket to be made of any one of a variety or a combination of materials; which enables adjustments and alignments while the limb is on the patient; and if necessary disconnection of the adapter and socket without disturbing the knee member connection with the lower portions of the limb.

A further object is to provide an improved knee member wherein the socket adapter is secured by a universal connection held in adjusted position by a single securing bolt, and which permits the making of future adjustments and alignment as required.

A still further object is to provide a knee structure which is usable without change in either a right or left limb assembly; and which is adapted for connection with any one of a plurality of different types of presently available hydraulic swing phase control devices, irrespective of whether the device is designed for connection in the front or rear of the main knee pivot. This feature enables the prosthetist to determine which swing phase device is best suited to a particular patient without changing the knee or shin alignment.

Another object is to provide a unique shin section having a shin element which is initially constructed so that it is adaptable by slight change for use either in a right or left assembly.

Another object is to provide an improved shin element having adjusting openings on opposite sides, these openings being aligned on a central axis on each side so as to accommodate different types of swing phase controls, when the shin element is selectively used for a right or left limb assembly.

Still another object of the invention is to provide a shin element having a unique extension which is adaptable as to length, the extension being associated with a unique foot section connector which enables using different foot types such as ankle type, solid ankle cushion heel, etc., and which enables the foot section to be adjusted at and between toe-in and toe-out positions as desired.

It is also an object to provide a universally adaptable artificial limb or leg structure which, after the required adjustments are made, may have a molded cosmetic shin slipped over the shin section so as to provide a complete structure having a natural appearance.

In accomplishing the above objects, it is possible with an artificial limb or a leg embodiment to make the present invention to fit a patient with a complete limb in a matter of approximately four hours as compared to the previously required period of time ranging, for example, from four days to three weeks.

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ARTIFICIAL LIMB HAVING ADJUSTABLE PARTS
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BRIEF DESCRIPTION OF THE DRAWINGS

Referring to the accompanying drawings, which are for illustrative purposes only:

FIG. 1 is a side elevational view of an artificial limb or leg embodying the features of the present invention, certain portions being cut away to disclose the cooperative relationship of internal parts thereof;

FIG. 2 is a front elevational view thereof;

FIG. 3 is a fragmentary sectional view through the knee section, taken substantially on line 3-3 of FIG. 1;

FIG. 4 is a transverse sectional view through the knee section, taken substantially on line 4-4 of FIG. 2;

FIG. 5 is a fragmentary view of a connected knee section and shin section, and having cutaway portions to disclose the manner of interconnecting one type of hydraulic swing phase control device therebetween;

FIG. 6 is a similar view illustrating the manner of mounting a tension adjusting device in the knee section, and;

FIG. 7 is a side elevational view of a shin member as initially fabricated prior to its adaptation for assembly into a right or left artificial limb structure.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring more specifically to the drawings, there is shown in FIG. 1 an artificial limb or leg embodying the features of the present invention, and in which the assembled structure comprises a thigh section 10, knee section 11, shin section 12 and foot section 13.

As will be best seen in FIGS. 1 and 3, the knee section 11 includes a knee member 14 which is connected between the thigh section and the shin section and includes a hollow casing structure of suitable material which is molded or otherwise formed to provide an inclined generally rounded front wall 15 and a generally spheroidal rear wall 16. The knee member is pivoted for fore-and-aft swinging movement at the upper end of the shin section by means of a transversely extending pivot member such as the shaft 17 having its opposite ends supported by the shin section, while the knee member has shaft receiving bearings 18 and 19 at its opposite sides.

The upper end of the knee member 14 is constructed with a circular opening 20 which is surrounded by an inwardly projecting annular edge flange 21 having a concave upper seating surface 21a. Extending above the knee member is an adjustable mounted adapter cup 22 which is constructed of suitable material so as to have an upward facing wall 22a which is slightly divergent towards its upper open end for receiving therein a socket member, as generally indicated at 23. The socket member is arranged to fit the thigh of the patient and since it is separately constructed from the cup adapter 22, the socket member may be made of any one of a number of materials such as wood, plastic or other rigid or semi-rigid material.

The bottom of the cup adapter 22 has an annular bottom wall 24 which surrounds a central opening 25, this wall having a convex surface 26 adapted to seat on the surface 21a of the knee member. The wall 24 has a similarly curved concave surface 27. In other words, the surfaces 21a, 26 and 27 have a common center of generality as indicated at the point 28. As thus arranged the cup adapter may be tilted and rotated to a multiplicity of positions for permitting alignment and adjustment between the thigh section and knee section. The associated parts are anchored in adjusted position by means of a nut 29 positioned above a front and rear wall 24 and having a lower surface conforming to the concave configuration of the surface 27. This nut has a depending lug 30 of smaller diameter than the opening 25 in the wall 24. The nut has a centrally threaded bore which extends through the lug 30 for receiving the threaded end of an anchor bolt 31 which extends through a passage 32 of the front wall 15 of the knee member and has a head portion seated within an enlarged access recessed portion 33 adapted to receive a suitable tool by means of which the bolt may be tightened and loosened. The bolt for such purpose may be provided with an Allen head. A universally adjustable connection is thus provided between the cup adapter 22 and the knee member 14 which permits adjustments of the cup (FIG. 2) whereby the prosthesis is enabled to make the required adjustment and alignments while the limb is still on the patient, and while the anchor bolt and associated nut hold the adapter connected to the knee member.

The shin section 12 includes a shank or shin member 34 which is constructed of appropriate material so as to form a hollow shell structure having a generally symmetrical outer wall 35, the shin member being tapered from its opened upper end towards its closed bottom end. A feature of the present invention resides in the construction of the shin member which permits it to be quickly and easily adapted for right and left limb assemblies. As shown in FIG. 7, the upper end of the shin member is provided with transversely aligned openings 36-36 (FIG. 4) for receiving the ends of pivot member 17 therethrough, and so that the pivot member will be positioned midway between the front and back extremities of the opening in the upper end of the shin member. As initially constructed, the upper edges of the opening on opposite sides of the pivot member axis are inclined and lie in corresponding downwardly diverging planes, these edges being indicated at 37a and 37b, and would constitute the cut back angle required at the forward side of the shin member, as shown in FIG. 1. By making the angular disposition of the edges 37a and 37b similar, it will be obvious that the shin member may be selectively rotated to 180° displaced positions in order to adapt it for a right or left assembly. When it is determined, whether the shin member will be in a right or left assembly, the side which is to be positioned at the back of the knee joint will then be cut out to conform the rearwardly disposed edge to a configuration as indicated by the phantom line 38a or 38b, and as shown as 38b in FIG. 1.

Referring to FIG. 1, it will be seen that the lowermost end of the shin member 34 is provided with a lower end wall 39 in which there is mounted a threaded bushing 40, this bushing being centrally positioned between the forward and back sides of the lower end of the shin member so that its vertical axis passes through the axis of the pivot member 17. Looking at FIG. 2, however, it is important to note that the central axis of the bushing as indicated at 41 is outwardly offset in a transverse direction of the shin member by approximately 3/4" with respect to the vertical axis 42 passing through the longitudinal central point of the knee pivot member 17. With this arrangement, the offset spacing with respect to the foot section will be automatically obtained when the shin member is selectively used in a right or left assembly.

In order to accommodate the shin section for the different length requirements required by different individuals, a simple variable extension arrangement is provided at the lower end of the shin member 34, this extension having a unique connection with the foot section 13 so that it may be properly adjusted to meet specific requirements. The extension, as will become apparent in the subsequent description, permits the use of various types of foot structures. For example, the foot structure may be of one of the well known types such as the ankle joint type or solid ankle cushion heel type. In either event, the foot structure is fitted with top socket means 43 fabricated of suitable material but preferably of metal formed to provide an attaching flange 44 and extending upwardly extending tab 45 adapted to form a socket to receive the lowermost end of a cylindrical spacer member 46 having its upper end in abutting relationship with the lower end wall 39 of the shin member. The foot section is retained in position by means of an elongate anchoring bolt 47 which extends through a passage 48 provided in the foot section, with the head of the bolt seated in a recessed portion.
49, the bolt head being adapted for accessible engagement by means of a suitable actuating tool by means of which the bolt head is adapted for deseaming or disengaging the bolt is threaded and is operatively engaged with the bushing member 40. This arrangement provides a simple and unique method for varying the length of the shin section. It is only necessary to provide a shorter or a longer spacer 46 as may be required to get the proper length. The socket member also provides an arrangement wherein the foot section may be laterally swiveled in order to provide toe-in, toe-out or other position of the foot section. The tubular extension is arranged so that it may be clampingly engaged with the associated end of the spacer, and this may be done by the usual expedient of slotting the tubular extension and providing spaced ears, one of which is indicated by the numeral 50, these ears having a conventional clamping screw 51. Thus, when they are in the desired adjustment, the anchor bolt 47 and clamping screw 51 may be tightened in order to retain the parts in the adjusted position.

A further important feature of the present invention resides in the versatility of the construction for the use of various types of ancillary devices such, for example, as a device for controlling the knee tension and the various types of available hydraulic swing phase controls, without having to rebuild or change the structure in order to accommodate these devices.

Referring to FIG. 1, there is shown one type of swing phase control which comprises an operatively associated cylinder 52 containing a piston (not shown) which is connected to a reciprocable projecting piston rod 53. This device is mounted within the shin member 54. The uppermost end of the cylinder 52 extends into an arcuate slot opening 54 provided in the rear wall 16 of the knee member 14. The slot walls, as shown in FIG. 4, are provided with thickened portions as indicated at 55 and 56 containing aligned passages for mountingly receiving a bolt member 57 so that it bridges the slot so as to form a pivot member upon which an attaching lug 58 at the upper end of the cylinder may be swiveled. The position of the lug 58 within the slot may be determined by the provision of suitable spacers, and in the present case this is done by providing an elongate tubular spacer 59 on one side of the lug and a similar elongate tubular spacer 60 on the other side of the lug. As thus arranged, the lug will be transversely centered within the slot opening 54. The outer end of the piston rod 53 is pivotally connected by a coupling 61 for swinging movement on a rod 62 which extends transversely of the lower end of the shin member 34 and has its ends supported in the opposite walls thereof; this rod having its longitudinal axis positioned midway between the front and back sides of the shin member. The swing phase device as just explained incorporates an adjustable element 63 which can be manually moved to different positions to vary the action of the device. Accessibility to this adjustable element is provided through an opening 64 in the adjacent wall of the shin member. In order to provide access to the control elements of the swing phase device, a plurality of prepositioned openings 64 are provided on the front and back sides of the shin element, as best shown in FIG. 2, so that when the shin member is reversed to accommodate it for right and left assemblies, the openings will be positioned properly for access to the adjustable element of the particular device installed. As viewed in FIG. 2, it will be observed that the openings on the front side and the openings on the back side are vertically aligned on opposite sides of the vertical axis 42.

As exemplified of a slightly different type of swing phase control device, there is shown in FIG. 5 an arrangement in which the similar elements to those of the swing phase device described above have been indicated with primed numbers. In this case, it will be observed that the piston rod 53' is connected to the bolt member 57' of the knee mechanism, while the cylinder 52', instead of being swingably mounted at its end is supported by a bearing lug 65 on one side which is adapted to receive a rod support 66 thereof, this rod support having its ends positioned in transversely aligned openings 67 arranged on opposite sides of the shin member. It will be noted that the axis of opposite openings 67 will be positioned intermediate the front and back walls of the shin member. Moreover, in order to provide for different swing phase devices, a plurality of variously spaced openings 67 are provided on each side of the shin member.

Devices are also mountable at the juncture of the knee member and shin member for controlling the knee tension. As exemplary of such a device, there is shown in FIG. 6 a tension controlling device as generally indicated at 68, this device being of well known construction. In this particular device, there are provided a plurality of alternate fixed and movable disks or shims (not shown) on the shaft 17. The fixed shims are attached to an anchor arm 69 which extends downwardly into the upper end of the shin member and is secured by a screw 70 which is mounted in an opening 71 on the front side of the shin member with its head exposed for easy access so that it can be tightened in the mounting position. The tension is controlled by a tension adjusting wheel 72 on the shaft 17, this wheel being positioned in the slot 54 so as to be easily accessible for moving one direction to increase the tension and in an opposite direction to decrease the tension.

It is to be understood that the various exemplary auxiliary devices as described above have been considered for the purpose of illustrating the versatility of the herein described invention, and obviously other structures may be provided for by the provision of proper mounting and access openings.

From the foregoing description and drawings, it will be clearly evident that the foregoing objects and features of the invention will be accomplished.

Various modifications may suggest themselves to those skilled in the art without departing from the spirit of my invention, and, hence, I do not wish to be restricted to the specific form shown or used mentioned, except to the extent indicated in the appended claims.

I claim:
1. An artificial limb structure having adjustable parts, comprising:
(a) a knee section in which a joint unit interconnects a shin section and a thigh section having a stump receiving socket member;
(b) said joint unit including a knee member swingably pivoted at the upper end of said shin section, and an adapter cup receiving the lower end of said socket member internally therein;
(c) universal connection means positioned between said adapter cup and said knee member, whereby the position of the thigh section may be rotatably adjusted about its axis, and axially tilted to different positions with respect to the knee member, said universal connection means including interfitting spheri-

cal wall surface areas of engagement on said cup member and said knee member, and having central openings in registration;
(d) an anchor member having a diameter substantially less than the diameters of said openings carried by said knee member with a threaded end extending through said openings; and
(e) a nut member on said threaded end having a spherical surface engaged with an adjacent internal spherical surface on said cup member wall for retaining the cup member and knee member in adjusted positions, said anchor member having a head extending through said knee member which is positioned at a location accessible from the exterior of said knee member while being worn and without alteration of the leg structure.
2. An artificial limb structure having adjustable parts, comprising:
(a) a knee section in which a joint unit interconnects a shin section and a thigh section having a stump receiving socket member;
(b) said joint unit including a knee member swingably pivoted at the upper end of said shin section and an adapter cup receiving the lower end of said socket member;
(c) universal connection means positioned between said adapter cup and said knee member, whereby the position of the thigh section may be rotatably adjusted about its axis, and axially tilted to different positions with respect to the knee member; and
(d) said shin section comprising an elongate hollow shell of generally symmetrical configuration, and tapering from an enlarged open top end to a smaller bottom end closed by an end wall, said top end having transversely aligned openings receiving a connecting pivot pin in a position in which the pin axis substantially at its midpoint is intersected by a central axis of the top end opening of the shell, said bottom end of the shell having a central axis laterally offset relative to the top central axis in the direction of the pivot pin axis, and said top end being formed on opposite sides of the pivot pin axis with substantially similar end edge cut-out portions increasingly relieved in each case from points adjacent said openings to substantially a midpoint in right angled relation to said pivot pin axis, whereby said shin section is selectively reversible for use in a right or left limb assembly, while retaining the offset relation of the top and bottom central axes.

3. An artificial limb structure according to claim 2, wherein the shin section includes an extension; and closure means at the bottom end of the shell structure including means attenuating said extension, said extension being adapted for connection with a foot section.

4. An artificial limb structure according to claim 3, including a foot section wherein said extension comprises a tubular spacer having one end abutting said closure means and its other end seated in socket means carried by said foot section, said socket means having elements permitting angular adjustment of the position of the foot section; and an elongate retaining member extending through said spacer and socket means, one end of said retaining member being anchored in said foot section and its other end having threaded engagement with a threaded passage in said closure means.

5. As an article of manufacture, a universal shin section adapted for use in right and left artificial limb assemblies, comprising:
(a) an elongate hollow shell structure of generally symmetric configuration, and tapering from an enlarged open top end to a smaller bottom end;
(b) said top end having transversely aligned openings for receiving a pivot pin in a position in which the pin axis substantially at its midpoint is intersected by a top central axis of the top end opening;
(c) said bottom end having a central axis laterally off-set relative to the top central axis in the direction of the pin axis; and
d) said top end being formed initially on opposite sides of the pin axis with substantially similar cut-out end edge portions increasingly relieved in each case from points adjacent said openings to substantially a midpoint in right angled relation to said pin axis, whereby said shin section is selectively reversible for use in a right or left limb assembly while retaining the offset relation of the top and bottom central axes.

6. An article of manufacture according to claim 5, including closure means at the bottom end of the shell structure, said closure means including a bushing member having a threaded passage coaxial with said bottom central axis.

7. An article of manufacture according to claim 5, wherein the shell structure is provided with a plurality of prepositioned tool access openings from the exterior to the interior thereof.

8. An article of manufacture according to claim 7, wherein said access openings comprise a plurality of transversely aligned similar openings on opposite sides of said shell structure, the openings on each side being spaced longitudinally of the shell structure and having their centers lying substantially on a transverse common plane including one of said central axes of said shell structure.

9. An article of manufacture according to claim 8, including other longitudinally spaced prepositioned transversely aligned openings in opposite sides of the shell structure for mounting actuating devices positioned therein, said openings being substantially in right angled relation to said access openings.

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