Nov. 14, 1967 F. MIDDLETON 3,351,955

ARTIFICIAL LEG HAVING A KNEE JOINT CONSTRUCTION WHICH SELECTIVELY PERMITS EITHER MANUAL OR AUTOMATIC ROTATION BETWEEN THE STUMP UNIT AND LOWER LEG UNIT

Filed Dec. 30, 1964 2 Sheets-Sheet 1

Fig. 1.

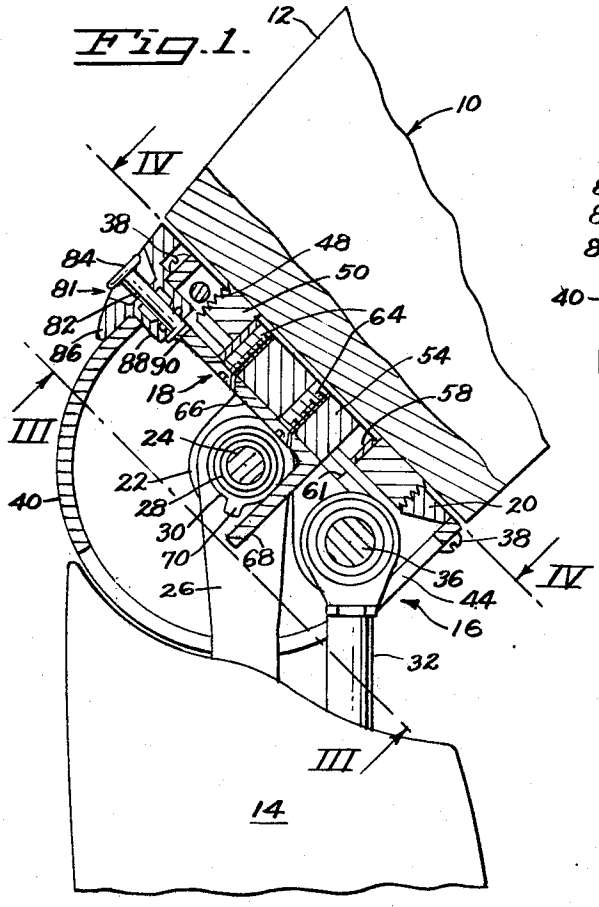


Fig. 2.

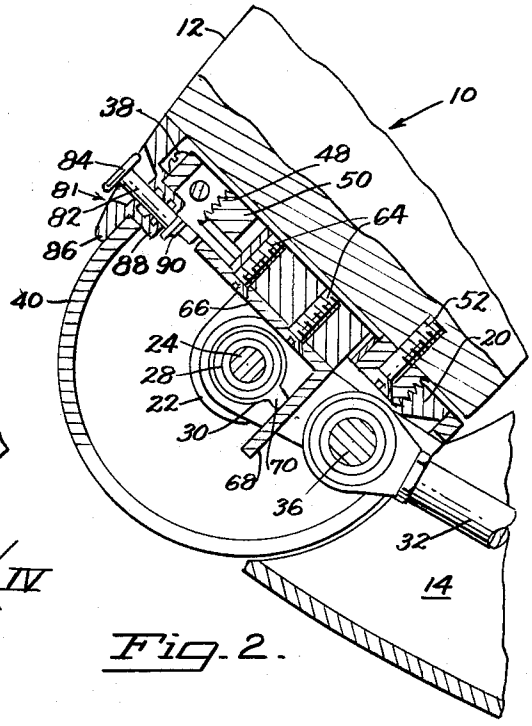


Fig. 3.

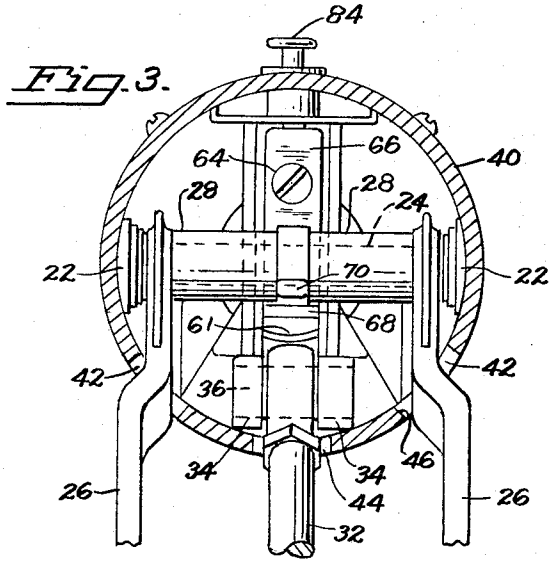
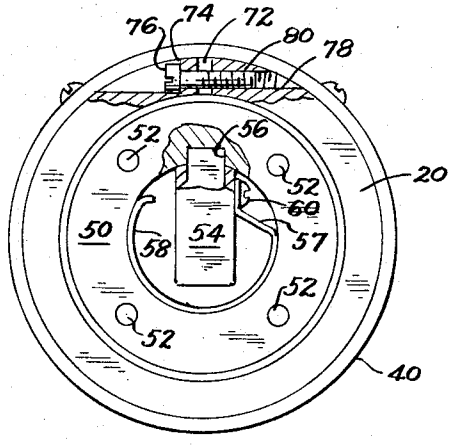


Fig. 4.



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Fig. 5.

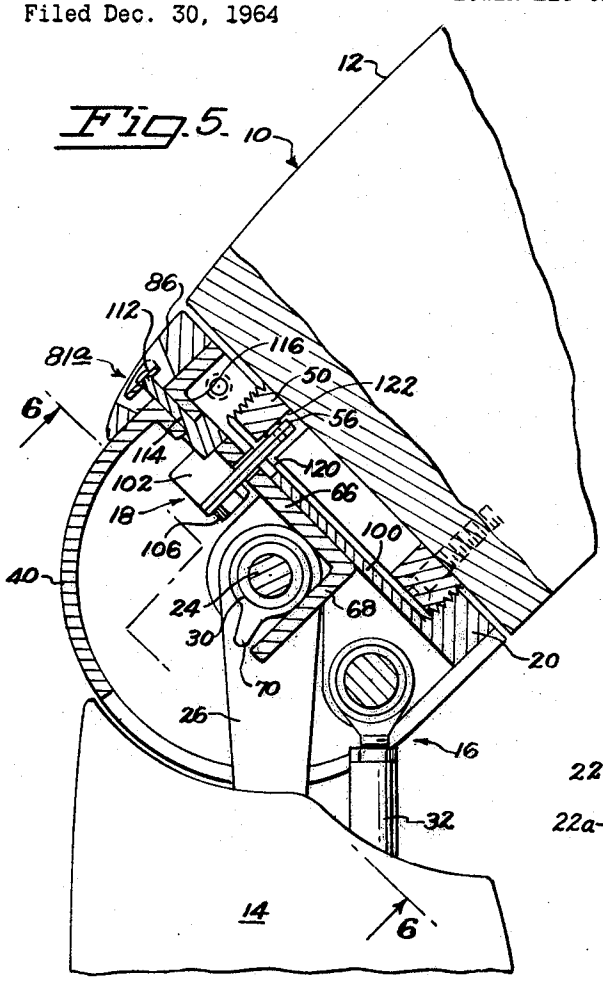


Fig. 9.

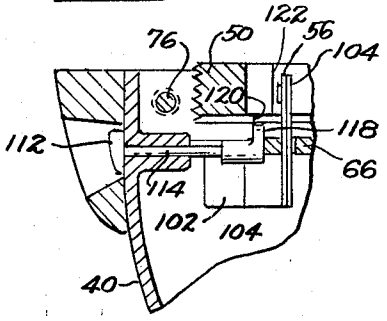


Fig. 6.

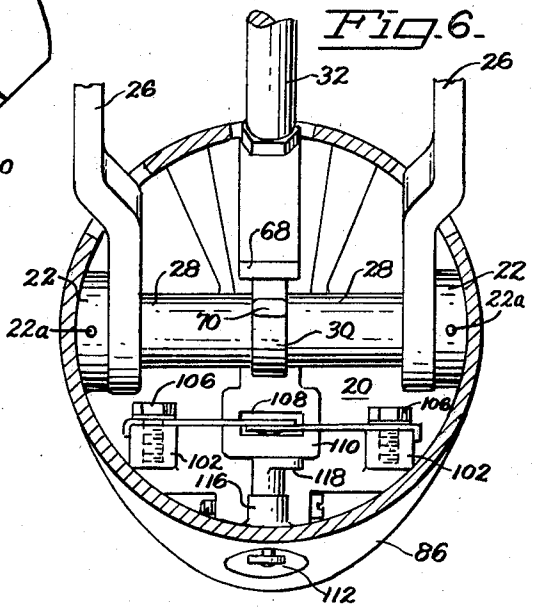


Fig. 7.

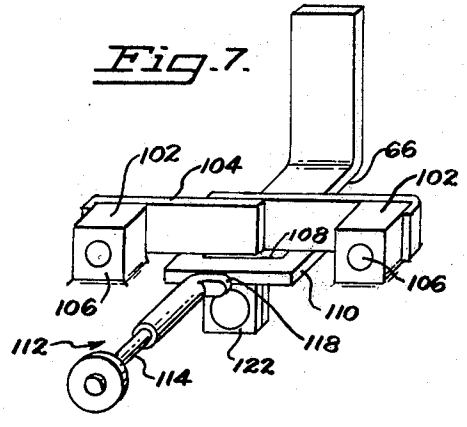
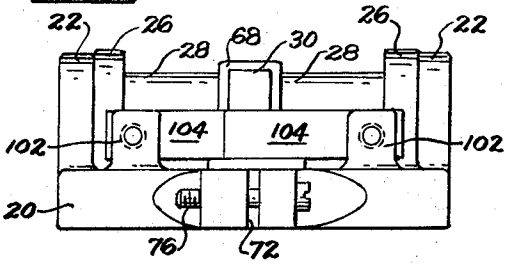


Fig. 8.



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6 Claims. (Cl. 3—22)

ABSTRACT OF THE DISCLOSURE

In an artificial leg having a stump unit for receiving the remaining portion of the wearer's thigh and an articulating lower leg portion connected to the stump unit through a hinged swingable knee joint, a rotatable assembly associated with knee joint which allows the leg portion to rotate relative to the stump unit, after the joint has been flexed a preselected amount, with accompanying lock and release means operated by the flexing movement between the stump unit and the lower leg portion.

In attempting to incorporate mechanisms operating to duplicate the motion and the freedom of movement inherent in a natural leg, various types of structures incorporating purely mechanical and hydro-mechanical devices have been developed. Although prior art devices have been successful in solving many problems of controlled articulation, problems are encountered by the wearer in achieving a sitting position in which strain is relieved and in permitting a stable position when it is desired to put on or remove socks, shoes, and trousers.

The present invention discloses a new and improved knee joint which not only permits the wearer to overcome the above difficulty but also is constructed and arranged so that one may assume a cross-legged position on the floor or allow the wearer to rotate the stump unit relative to the leg unit which is particularly desirable during athletic activities, such as golf, and thereby enabling the wearer to achieve a full pivot on the swing.

An ever-present and critical hazard to the wearer is presented in the event of a fall. If the leg should remain rigid or substantially rigid, during a fall, the chances of producing a hip fracture or other serious damage to the body is greatly increased. The knee joint of this invention automatically conditions the knee joint to permit substantially unlimited transverse rotation of the leg unit about the longitudinal axis of the stump unit and thereby decreases the chances of fracturing or damaging the hip joint.

Accordingly, it is an object of this invention to provide a new and improved knee joint for an artificial leg.

Another object of this invention is to provide a new and improved knee joint adapted to permit lateral movement of the leg unit relative to the stump unit when the knee is bent a predetermined amount.

A further object of this invention is to provide selectively operable means permitting the leg unit to rotate relative to the stump unit.

Another and further object of this invention is to provide a new and improved knee joint being adapted for automatically conditioning the leg unit to rotate in a transverse direction relative to the stump unit in order to facilitate placement or removal of a shoe or sock from the artificial foot.

The foregoing and other objects and advantages of the present invention will become apparent to those skilled in the art upon consideration of the following detailed description of the preferred embodiment thereof,

reference being had to the accompanying sheet of drawings wherein:

FIG. 1 is a side elevation, partly in section, of a knee joint constructed in accordance with the principles of this invention.

FIG. 2 is similar to FIG. 1 but showing the leg unit rotated at least 90° with respect to the stump unit.

FIG. 3 is a transverse section taken substantially along the line III—III of FIG. 1.

FIG. 4 is a transverse section taken substantially along line IV—IV of FIG. 1.

FIG. 5 is a longitudinal section of a modified form of the knee joint of this invention incorporating a knee release mechanism of simplified construction.

FIG. 6 is a transverse section of FIG. 5 taken substantially along the line VI—VI.

FIG. 7 is a perspective showing the constructional details of the manual release mechanism.

FIG. 8 is a front elevation of FIG. 6 with the knee cap removed.

FIG. 9 illustrates the position assumed by the manual knee release mechanism when it is positioned to allow rotation of the knee.

Referring now to the drawings, the novel artificial leg constructed in accordance with the principles of this invention is generally indicated by the numeral **10** and includes a stump unit or socket **12**, a leg unit **14**, and a knee joint **16**. The knee joint **16** is constructed and arranged to permit transverse rotation of the leg unit relative to the longitudinal axis of the stump unit.

In accordance with the basic feature of this invention, the knee joint **16** is provided with means, indicated by the numeral **18**, which is arranged to allow the stump socket to be automatically or manually selectively operated in order to enable the leg unit to rotate about its longitudinal axis relative to the stump unit. Such means comprise a saddle member **20** which is generally circular in configuration and includes projecting ear portions **22** which have axially aligned bores for receiving a transverse shaft **24**. The shaft is positively retained in position by set screws **22***a* in the ear portions. Leg support members **26** are joined together with a cross tube **28**. This cross tube contains bushing bearings which support and space the leg assembly and allow rotation on the transverse shaft **24**. Solidly fixed midway on the cross tube **28** is a cam member **30**. Located rearwardly and between the leg members **26** is an additional leg member **32** which is mounted for pivotal movement between projecting cheeks **34** through which extends a short pivot shaft **36**. As is known to those skilled in the art, the leg members **26** and **32** are associated with hydraulic devices (not shown) whose function is to control the action or movement of the leg unit relative to the stump unit during normal walking.

The saddle member **20** is secured, by means of a plurality of circumferentially spaced screws **38**, to a generally spherical knee cap **40** which is suitably slotted (FIG. 3) at **42**, **44** and **46** to accommodate the leg members **26** and **32** when the leg unit is rotated about the shaft **24**. As shown in FIGS. 1 and 2 the saddle member **20** includes a threaded bore **48** within which is threadedly mounted an annular ring member **50** secured to the lower end of the stump unit by a plurality of screws **52**. As shown in FIG. 4, a lock bar **54** is located within the bore of the ring member **50** and has the end thereof formed to be received within a key slot **56** provided on the ring **50**. The lock bar **54** is associated with resilient means for urging it into the key slot **56** and such means preferably comprises a spring **58** in contact with a portion of the inner periphery of the ring **50** and having an inwardly extending end portion **57** secured to the lock bar by a screw **60**. It will be apparent that the lock bar **54** can be withdrawn from the key slot

56 by imparting a force against the tension of the spring 58.

The saddle member 20 is provided with a rectangular opening 61 such that when the ring member 50 is in assembled relation with the saddle 20 a portion of the lock bar 54 extends through the slot and has attached thereto, by means of fasteners 64, a generally L-shaped lock bar actuator 66. This actuator comprises a leg portion 68 projecting generally normal to the surface of the saddle member 20 and is maintained in contact with the surface of the cam 30. By this arrangement, when the leg unit is rotated about the axis of the shaft 24, as shown in FIG. 2, the lobe 70 of the cam member 30 engages the leg 68 causing the lock bar 54, which is attached to the lock bar actuator 66, to be withdrawn from the key slot 56 against the bias of the spring 58 permitting relative rotation between the saddle member 20 and the annular ring member 50.

Thus it is seen that this invention provides a pair of relatively rotating members which are normally held against rotation with means provided therewith being operable, when the leg unit assumes an orientation of approximately 90° with respect to the stump unit, for allowing rotation between the two members.

In order to adjust the relative freedom of rotation between the saddle member 20 and the annular ring member 50, the saddle member is slotted at 72 and provided with an undercut of a milled flat 74. An adjustment screw 76 having its head seated against the flat 74 is threaded into the tapped portion 78 of a bore 80. It is apparent that upon tightening of the screw 76 the threaded portion of the saddle 20 experiences a slight reduction in diameter which accordingly results in a closer fit for the threads on the ring 50.

According to another feature of this invention manually operable means are provided for permitting relative rotation between the ring member 50 and the saddle member 20. Such means are generally indicated by the numeral 81 and comprise a cylindrical plunger 82 having a head portion 84 extending through a blended fillet 86 defining a transition surface between the stump unit and the knee joint. The cylindrical plunger 82 extends through a guide bushing attached to or part of the knee cap 40. Its inner end is aligned with the end surface of the lock bar actuator 66 and the lock bar spring maintains the plunger in the retracted position. It will be noted that when the plunger is depressed by the wearer against the bias of the lock bar spring, it displaces the lock bar 54 from the key slot 56, allowing relative motion between saddle member 20 and the ring 50. According to the above construction, it is apparent that to maintain the lock bar out of the key slot 56, a slight amount of rotation of the plunger 82 will lock the end lip at the end of the lock bar guide slot 61 in the saddle member 20. If it is desired to maintain the lock bar out of engagement with the key 56, a latch or detent mechanism can be incorporated with the plunger 82 holding the plunger in its depressed position.

Thus, according to this invention, a very simple and dependable apparatus is provided in which two relatively rotating members 20 and 50, one of which is rigid with the leg unit and the other rigid with the stump unit, may be operated so that upon bending of the artificial leg a predetermined amount the relatively rotatable members are conditioned to permit rotation of the leg unit relative to the stump unit.

The embodiment of the invention shown in FIGS. 5–9 fulfills the same function of allowing automatic or manual rotation of the stump unit 12 relative to the leg unit 14. In fulfilling these functions, the modified construction eliminates the need of the lock bar 54 and its associated spring 58 resulting in a simplified construction.

Referring now to FIGS. 5, 6 and 7, wherein like numerals refer to corresponding structure described in connection with FIGS. 1–4, it will be seen that the saddle member 20 is formed to provide a solid wall 100 on the surface of which is situated the lock bar actuator 66. Upwardly extending transversely aligned posts 102, integral with the saddle member 20, have generally L-shaped leaf springs 104 attached thereto by cap screws 106, and as seen most clearly in FIGS. 6 and 7, the inner ends of these springs are overlapped and extend through a clearance slot 108 formed in an enlarged end 110 of the lock bar actuator 66. The portion of each leaf spring 104 extending through the clearance slot 108 is of sufficient length to be received in the key slot 56 of the annular ring 50. While in the position shown in FIG. 5, relative rotation between the saddle member 20 and the annular ring 50 is prevented.

When the wearer of the artificial leg sits down causing pivotal movement between the stump unit 12 and the leg unit 14, the leg portion 68 of the actuator bar 66 comes in contact with the cam 70 moving the actuator 66 rearwardly which in turn causes the leaf springs 104 to deflect and become disassociated from the key slot 56. Upon such an occurrence it is apparent that rotation between the saddle member 20 and the annular ring 50 may take place.

The manual release mechanism of the modification shown in FIGS. 5–9 comprises a plunger 112 having a reduced diameter portion 114 freely mounted in a bored boss 116 provided on the knee cap 40. The inner end of the plunger is seated against the end of the actuator 66 in order to move the actuator inwardly thus moving the portions of the springs 104 inwardly out of engagement with the key slot 56. The inner end of the plunger 112 is formed with a transversely extending latch 118 which is operative to position the portion of the leaf springs 104 extending in the key slot 56 out of engagement with such slot when the wearer depresses the plunger 112 inwardly and rotates it 90° so that the latch is seated in a slot 120 formed in the saddle member 20. The relative position of the plunger when the latch 118 is seated in the slot 120 is shown in FIG. 9.

Since the material from which the leaf springs 104 are made is rather tough as compared to the annular ring 50, which is preferably made of Teflon, the leaf springs would cause gouging of the bore of the annular ring 50. To prevent such damage, especially when the leaf springs 104 are located in the slot by the plunger 112, a generally convex button 122 is suitably secured to the inner one of the leaf springs 104.

Thus, it will be seen that a knee joint constructed to incorporate the features shown and described in FIGS. 5–9, is of a very simplified construction wherein the elements themselves are easy to manufacture and they are correlated in a combination having a high degree of reliability so that they may perform their intended function over a long period of time.

I claim:

1. An artificial leg comprising a stump unit and a lower leg assembly connected through a swingable knee joint, said knee joint comprising a first member secured to said stump of said artificial leg, a second member rotatably mounted on said first member and secured to said leg assembly, lock means operable between said members to hold them against rotation, and release means operable after a preselected rearward swinging movement of said leg assembly relative to said stump whereby said lock means holding said first and second members against rotation is released allowing said leg assembly to rotate relative to said stump unit.

2. The artificial leg as defined in claim 1 wherein the lock means include a lock bar reciprocally mounted on the second member and biased against the first member for locking the engagement, and a key slot in said first member for receiving said lock bar whereby relative rotation between the leg assembly and stump unit is prevented during registered engagement.

3. An artificial leg which includes a stump unit and a leg unit interconnected by a knee joint; an externally threaded annular ring secured to said stump unit, a saddle member having a threaded bore threadedly engaged with

said annular ring, a lock bar slidably mounted on said saddle member and located in the bore of said ring member, a key slot on said annular ring for receiving one end of said lock bar, means for urging said lock bar in said key slot, a transverse shaft rotatably supported by said saddle member, a cam member keyed on said shaft, and means operated by said cam member for disengaging said lock bar from said key slot.

4. An artificial leg having a stump unit and a leg assembly connected through a swingable knee joint comprising a pair of relatively rotatable members one of which is secured to said stump unit and the other of which is secured to said leg assembly, lock means mounted on one of said members for engagement with the other member for preventing relative rotation between said members, release means operable in response to swingable movements between said stump unit and said leg assembly for releasing said locking after a preselected swinging movement between said stump unit and said leg assembly and separate release means for releasing said lock means independent of the relative position of said stump unit and said leg assembly.

5. A rotatable knee joint interconnecting a leg assembly and a stump unit of an artificial leg comprising a

saddle member rotatably supporting leg operating linkages, an annular externally threaded ring threadedly connected in a bore in said saddle member, a key slot in said annular ring communicating with the bore, lock means resiliently mounted on and extending through said saddle member to engage such key slot in said annular ring and release means for displacing said lock means from said key slot, thereby freeing said annular ring and said saddle member for relative rotation.

6. The structure as defined in claim 5 wherein the lock means includes a pair of L-shaped leaf springs secured to and extending through said saddle member for engaging the key slot.

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