Sept. 4, 1956 J. WEIH 2,761,245

SIMULATED LIMB JOINT CONSTRUCTION

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FIG. 1.

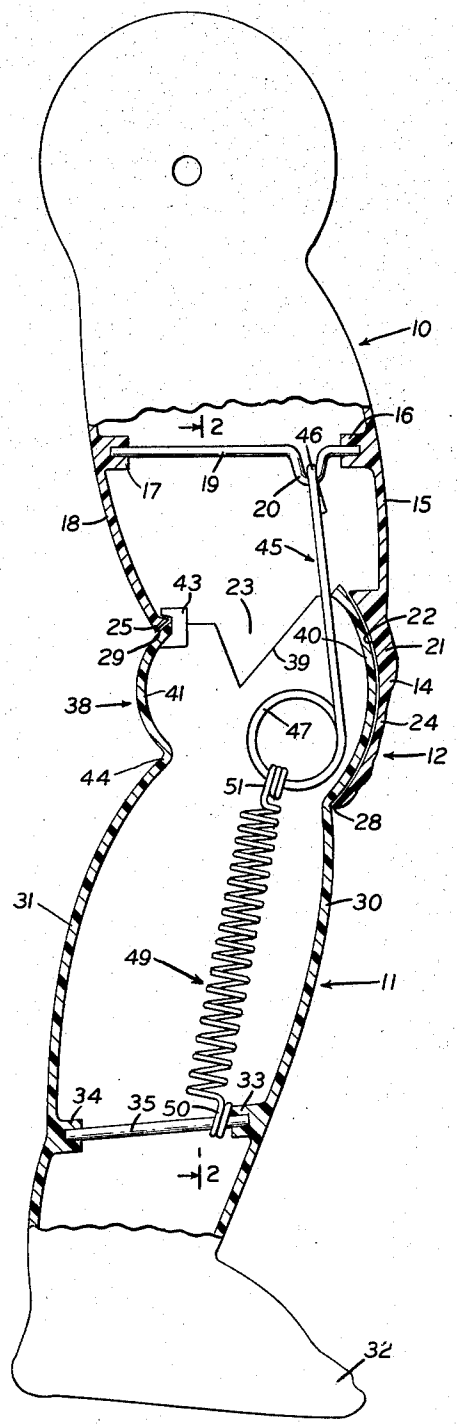


FIG. 3.

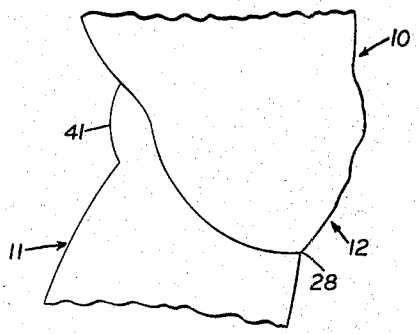
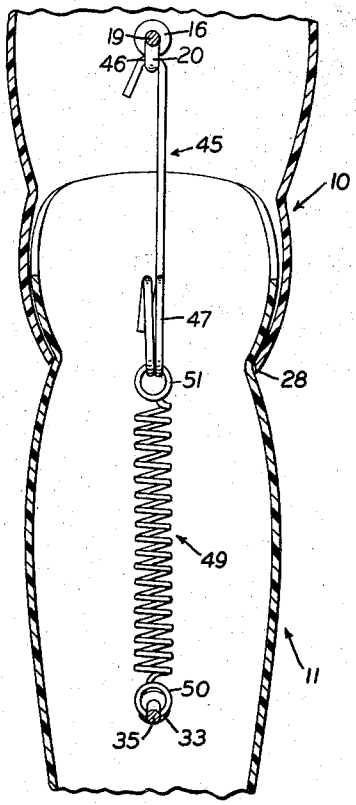


FIG. 2.



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FIG. 6.

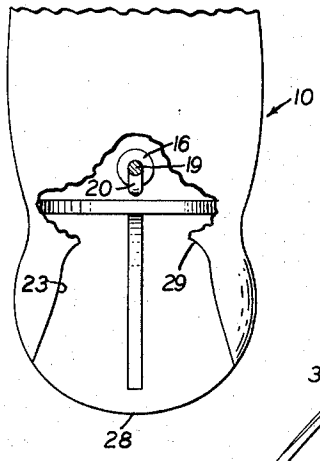
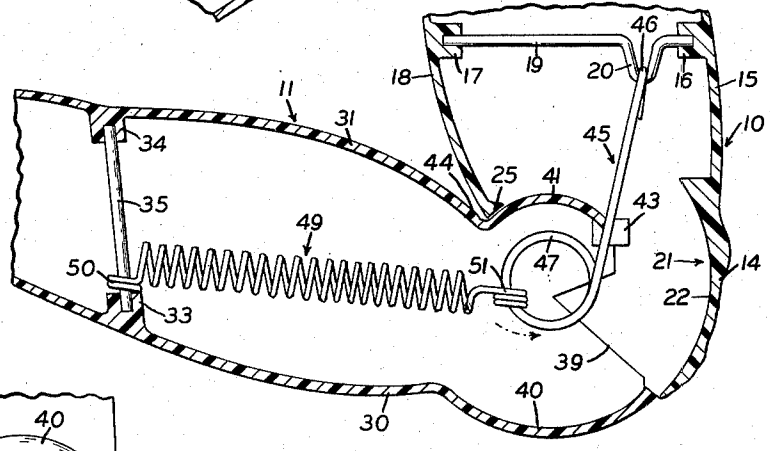


FIG. 4.

FIG. 5.



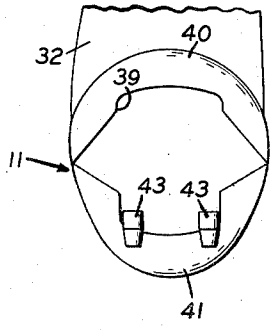


FIG. 7.

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2,761,245

SIMULATED LIMB JOINT CONSTRUCTION

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Application November 1, 1954, Serial No. 465,923

8 Claims. (Cl. 46—173)

This invention relates generally to simulated limb constructions, and is particularly concerned with accurately simulated human or animal limbs having articulated members of the general type disclosed in my prior copending patent applications Ser. Nos. 428,920 filed May 24, 1954, and 437,354 filed June 17, 1954, the instant invention being an improvement over such disclosures.

The particular embodiment of the present invention, which is illustrated in the drawings and which will be described hereinafter in greater detail, comprises generally a pair of simulated limb members, and connecting means serving to hold the limb members together and permit life-like, relative swinging movement of the limb members.

It is a general object of the present invention to provide a simulated limb construction of the type described in which the members are movable relative to each other to afford the realistic appearance of a human or animal limb, and which may be utilized in dolls, puppets, artificial animals and various other devices to accurately simulate walking and other normal limb movements.

It is another object of the present invention to provide a simulated limb construction having the advantageous characteristics mentioned in the foregoing paragraph, which may be simply and easily manipulated, even by a small child, to present the life-like appearance of a wide variety of limb positions. In addition, the limb construction of the present invention is adapted to be self-retaining in substantially any desired position into which it may be manipulated, while being readily releasable for further manipulation into different positions.

It is a more particular object of the present invention to provide a simulated limb construction of the type described, in which the limb member connecting means serves both to hold the members together and maintain the members in a wide variety of angular dispositions. Further, the novel limb construction of the present invention permits of actuation (relative movement of the limb members) by a small and substantially constant force, over practically the entire range of relative angular dispositions. That is, there are no "dead" positions through which it is relatively difficult to effect swinging movement of the limb members.

It is a further object of the present invention to provide a simulated limb construction having the advantageous features mentioned above, which is simple and durable in construction, wherein normal wear of the limb members is automatically compensated for or taken up to afford long continued, trouble-free operation, and which can be manufactured and sold at a reasonable cost.

Other objects of the present invention will become apparent upon reading the following specification and by referring to the accompanying drawings, which form a material part of this disclosure.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts, which will be exemplified in the construction

hereinafter described, and of which the scope will be indicated by the appended claims.

In the drawings:

Figure 1 is a side elevational view, partly broken away, showing a simulated leg constructed in accordance with the present invention, the lower leg member being illustrated in its substantially aligned relation with respect to the upper leg member or thigh;

Fig. 2 is a sectional view taken substantially along the line 2—2 of Fig. 1;

Fig. 3 is a partial, elevational view showing the external appearance of the joint connecting the upper and lower leg members;

Fig. 4 is a partial, vertical sectional view similar to Fig. 1, and showing the lower leg member in an intermediate rearwardly angulated position with respect to the upper leg member;

Fig. 5 is a partial, sectional view similar to Fig. 4 showing the rearward leg member in its fully angulated position with respect to the upper leg member;

Fig. 6 is a partial, rear elevational view of the lower portion of the upper leg member, with parts broken away for purposes of illustration; and

Fig. 7 is a top plan view of the upper end of the lower leg member.

While the limb construction of the present invention is equally well adapted for simulating a wide variety of limbs, both human and otherwise, the invention has been primarily developed and employed in connection with doll legs, and will be described hereinafter with particular reference thereto.

Referring now more particularly to the drawings, the embodiment of the invention illustrated therein comprises a simulated thigh or upper leg member, generally designated **10**, and a simulated lower leg member, generally designated **11**, which is articulated to the thigh member by the joint **12**.

The thigh member **10** is preferably hollow and of generally ovaloid cross-section. The front or forward wall portion **15** of the thigh member **10** is provided with an internal boss **16** adjacent to and spaced above the lower end of the thigh; and an oppositely disposed, internal boss **17** is formed on the back or rearward thigh wall portion **18**. Extending between the internal bosses **16** and **17**, and having its opposite ends secured therein, is a rod **19**, which is formed with a downwardly bent or looped portion **20** adjacent to and spaced from the forward wall portion **15**.

The inner limb-member or thigh member **10** has a lower or forward end **23**. A socket, generally designated by the reference numeral **21**, is provided at the joint **12**. A bulb-shaped bearing **38** is provided in leg member **11** at joint **12**.

As viewed in Fig. 1, the rear wall-portion of thigh member **10** terminates in a bottom end-wall **25**; socket **21** has a front wall portion or extension **24** which has an external rib **14** and an internal bearing face **22** and a bottom end **28**; bearing **38** has a front wall portion **40** which interfits with bearing face **22**; bearing **38** has a rear wall portion **41** which has an upper end-wall **29** which interfits with end-wall **25** of thigh member **10**; and there is an angular junction **44** at the bottom of rear wall portion **41**.

In Fig. 1, the reference numerals **41** and **40** designate arcs of respective circles of different respective radii, having a common center. This common center is on a pivotal axis of relative turning movement between thigh member **10** and leg member **11**. Said pivotal axis is a transverse axis of the joint **12**. Said pivotal axis is perpendicular to the plane of Fig. 1. As seen in Fig. 5, the relative turning movement between thigh member **10** and leg member **11** is not more than 180°. When the leg

member 11 is turned clockwise, as viewed in Fig. 1, from its normal longitudinally alined position of Fig. 1, the bearing 38 is guided at the bearing face 22 and at the end-wall 25 of thigh member 10.

At its rear, the bearing 38 has hooked stop lugs 43. When the leg member 11 is in its normal longitudinally alined position of Fig. 1, said stop lugs 43 abut and engage the rear portion of thigh member 10, so that, as viewed in Fig. 1, the outer leg member 11 cannot be turned counterclockwise or reversely relative to thigh or inner member 10, when leg member 11 is in its normal position of Fig. 1.

The lower leg member 11 is also preferably hollow, including front and rear wall portions 30 and 31, respectively, and a lower end foot simulating portion 32. Interiorly of the lower leg member 30 on the forward and rearward wall portions, respectively, are formed opposed bosses 33 and 34 which support opposite ends of a rod 35. The rod 35 is preferably inclined forwardly for a purpose appearing presently.

The socket 21 is adapted to conformably receive the bulb 38, the latter being rotatably engaged within the socket. As both the socket and bulb are substantially ovaloid in horizontal section, relative rotation will be constrained about a single transverse, substantially horizontal axis.

Depending from the rod 19, through the thigh opening 23 and the bulb cutout 39, into the bulb 38 is a link or connecting member, generally designated 45. The link 45 is preferably formed of stiff wire and has its upper end hooked, as at 46, and engaged over the looped rod portion 20 to define a pivotal connection between the rod 19 and link. The lower portion of the wire link 45 is coiled to form a rearwardly enlarged loop or abutment 47, which is disposed within the bearing 38.

A resiliently extensile and contractile tension member, generally designated 49 is disposed interiorly of the lower leg member 11, and may comprise a helical coil spring, as shown in the drawings, an elastic band, or other suitable tensioning device, as desired. The lower end of the tension member 49 is coiled about the rod 35, as at 50, and the upper end of the tension member is coiled about a portion of the loop 47 as at 51. As the spring 49 is held under tension, its lower end 50 will be drawn forwards along the forwardly inclined rod 35 and maintained in a position adjacent to the boss 33. Thus, it will now be understood that the link 45 and tension member 49 serve to hold the bulb 38 in engagement within the socket 21, while the loop 20 in the bar 19 and the inclined disposition of the bar 35 serve to position the link and tension member relative to the axis of swinging movement of the upper and lower leg members 10 and 11.

As seen in Fig. 1, the loop 47, connecting the link 45 and tension member 49, is disposed forwardly of the axis of limb member rotation, so as to yieldably maintain the limb members in the illustrated straight or aligned position. However, upon slight rearward angular movement or swinging of the lower limb member 11 relative to the upper limb member 10, to the position illustrated in Fig. 4, the connecting loop 47 shifts rearwardly into abutting engagement with the rearward bulb portion 41. In this position, the connecting loop 47 of the link 45 is disposed generally in alignment with or in close proximity to the transverse axis of relative limb member movement, so that the force exerted by the spring 49 will be in substantial alignment with the last named axis. Hence, there will be little or no component of the spring force tending to cause rotation of the lower limb member relative to the thigh member, and swinging movement of the lower limb member may therefore be effected by merely overcoming the frictional resistance in the joint 12. The condition in which the connecting loop 47 is disposed in close proximity to the axis of limb member rotation is approximated throughout the rearward angulation of the lower limb member 11 to the extreme position of Fig. 5. Of course, forward swinging movement of the lower limb member effects mere reversal of the above described operation, wherein the connected ends of the link 45 and tension member 49 are disposed in close proximity to the axis of limb member rotation throughout a substantial portion of the latter rotation, to substantially eliminate or effectively reduce all spring force components tending to effect relative swinging movement of the limb members. As the lower limb member 11 approaches its forwardmost, aligned position of Fig. 1, the connected ends of the tension member 49 and link 45 will shift forwardly of the limb member axis and effect a slight kicking of the lower limb member into its aligned position.

It will now be apparent that the above described doll limb construction affords a substantially constant resistance to swinging movement of the limb members throughout a substantial portion of its swinging movement. Further, such resistance is determined by the tension or strength of the tension member 49 and the snugness of fit between the socket 21 and bulb 38, which are preferably predetermined so that the lower limb member will be self-retaining in any selected position of its angular disposition with respect to the upper limb member over that portion of the lower limb swinging movement in which the connecting loop 47 is in the immediate region of the limb rotation axis. Of course, the spring must be of sufficient strength to resiliently hold the upper and lower limb members together, so as to take up any looseness therebetween and thus compensate for wear.

While the leg members have been illustrated in the drawings as formed of plastic material, which is preferred for its molding characteristics and surface qualities, it is appreciated that other suitable materials may be employed without departing from the spirit and scope of the present invention.

As viewed in Fig. 1, the tension spring 49 is located to exert a counterclockwise torque upon leg 11, but the longitudinal counterclockwise turning movement of leg 11 is prevented by the hook-stops 43. As shown in Fig. 1, the inner convex wall 22, which is longitudinally concentric with the pivotal axis of the joint, extends below said pivotal axis when the leg 11 is in its normal selected position of Fig. 1. The hook-stops 43 and the engagement of walls 22 and 40 below the pivotal axis, make it impossible to pull the leg out of the joint. The counterclockwise torque of spring 49 yieldingly maintains the leg 11 in its normal selected position of Fig. 1.

Fig. 4 shows an intermediate inclined position of leg 11. Due to the forward and upward inclination of rod 35, the lower spring-look 50 remains at the front wall of the leg 11.

In Fig. 4, the link 45 has been turned clockwise relative to thigh 10, from the position of link 45 in Fig. 1. In both Fig. 1 and Fig. 4, there is a straight line between the upper turnable end of link 45 and the lower spring-loop 50. In Fig. 4, it is clear that the tension of spring 49 exerts a clockwise torque on leg 11, which urges leg 11 to the fully inclined or kneeling position of Fig. 5.

When leg 11 is turned clockwise beyond its intermediate position of Fig. 4, the rear bearing-head wall 41 turns link 45 counterclockwise from its intermediate position of Fig. 4. Hence when the leg 11 is in its fully inclined position of Fig. 5, the spring 49 exerts little or no torque.

For convenience, the limb is defined in the claims with reference to the views of Figs. 1, 4, 5 and the inner limb member is defined as the thigh and the outer limb member is defined as the leg. However, it is clear that the invention is not limited to a lower limb.

From the foregoing, it is seen that the present invention provides a simulated limb construction which fully accomplishes its intended objects, and which is well adapted to meet practical conditions of manufacture and use.

Although the invention has been described in some detail by way of illustrating an example for purposes of clarity of understanding, it is understood that certain changes and modifications may be made within the spirit of the invention and scope of the appended claims.

What is claimed is:

1. A simulated limb which has a thigh member and a leg member which have a joint at their adjacent ends; said leg member being longitudinally turnable in said joint relative to said thigh about a pivot joint axis which is transverse relative to said thigh and leg; said leg being thus turnable counterclockwise about said pivot axis to a normal selected position and being thus turnable clockwise about said pivot axis out of said normal selected position, said thigh having a front thigh-wall and a rear thigh-wall; said leg having a front leg-wall and a rear leg-wall; said front thigh-wall having a front socket-extension in said joint which extends below the lower end of said rear thigh-wall; said socket-extension having an inner concave bearing face which is longitudinally concentric with said pivot axis in said turning directions; said leg having a bearing-head in said joint; said bearing-head having a front convex bearing-head wall which turnably interfits with said concave bearing face; said bearing-head having a rear bearing-head wall having an upper end portion, a hook stop carried by said upper end portion and having a rearwardly projecting hook portion, said lower end of the rear thigh-wall having an inwardly projecting abutment against which the hook portion strikes to arrest the counterclockwise movement of the leg and position the leg in a normal position, said hook stop being moved out of engagement with said abutment on the rear wall of the thigh when said leg is turned clockwise out of said selected normal position; said concave bearing face having a portion extending below said pivot axis and interfitting with that portion of said front convex wall which extends below said pivot axis when said leg is in said normal positon.

2. A smulated limb which has a thigh member and a leg member which have a joint at their adjacent ends; said leg member being longitudinally turnable in said joint relative to said thigh about a pivot joint axis which is transverse relative to said thigh and leg; said leg being thus turnable counterclockwise about said pivot axis to a normal selected position and being thus turnable clockwise about said pivot axis out of said normal selected position, said thigh having a front thigh-wall and a rear thigh-wall; said leg having a front leg-wall and a rear leg-wall; said front thigh-wall having a front socket-extension in said joint which extends below the lower end of said rear thigh-wall; said socket-extension having an inner concave bearing face which is longitudinally concentric with said pivot axis in said turning directions; said leg having a bearing-head in said joint; said bearing-head having a front convex bearing-head wall which turnably interfits with said concave bearing face; said bearing-head having a rear bearing-head wall which has a hook-stop; said hook-stop being located to engage said thigh when said leg is in said normal position; said hook stop being moved out of engagement with said thigh when said leg is turned clockwise out of said selected normal position; said concave bearing face having a portion extending below said pivot axis and interfitting with that portion of said front convex wall which extends below said pivot axis when said leg is in said normal position, said concave bearing face and said front bearing-head wall having non-circular lateral cross-sections to prevent said leg from turning sideways or twisting relative to said thigh.

3. A simulated limb which has a thigh member and a leg member which have a joint at their adjacent ends; said leg member being longitudinally turnable in said joint relative to said thigh about a pivot joint axis which is transverse relative to said thigh and leg; said leg being thus turnable counterclockwise about said pivot axis to a normal selected position and being thus turnable clockwise about said pivot axis out of said normal selected position, said thigh having a front thigh-wall and a rear thigh-wall; said leg having a front leg-wall and a rear leg-wall; said front thigh-wall having a front socket-extension in said joint which extends below the lower end of said rear thigh-wall; said socket-extension having an inner concave bearing face which is longitudinally concentric with said pivot axis in said turning directions; said leg having a bearing-head in said joint; said bearing-head having a front convex bearing-head wall which turnably interfits with said concave bearing face; said bearing-head having a rear bearing-head wall which has a hook-stop; said hook-stop being located to engage said thigh when said leg is in said normal position; said hook stop being moved out of engagement with said thigh when said leg is turned clockwise out of said selected normal position; said concave bearing face having a portion extending below said pivot axis and interfitting with that portion of said front convex wall which extends below said pivot axis when said leg is in said normal position, said rear bearing-head wall being also convex and being also longitudinally concentric with said pivot axis, said hook-stop being fixed to the upper end of said rear bearing-head wall and engaging the lower end of said rear thigh-wall when said leg is in said normal selected position.

4. A simulated limb which has a thigh member and a leg member which have a joint at their adjacent ends; said leg member being longitudinally turnable in said joint relative to said thigh about a pivot joint axis which is transverse relative to said thigh and leg; said leg being thus turnable counterclockwise about said pivot axis to a normal selected position and being thus turnable clockwise about said pivot axis out of said normal selected position, said thigh having a front thigh-wall and a rear thigh-wall; said leg having a front leg-wall and a rear leg-wall; said front thigh-wall having a front socket-extension in said joint which extends below the lower end of said rear thigh-wall; said socket-extension having an inner concave bearing face which is longitudinally concentric with said pivot axis in said turning directions; said leg having a bearing-head in said joint; said bearing-head having a front convex bearing-head wall which turnably interfits with said concave bearing face; said bearing-head having a rear bearing-head wall which has a hook-stop; said hook-stop being located to engage said thigh when said leg is in said normal position; said hook stop being moved out of engagement with said thigh when said leg is turned clockwise out of said selected normal position; said concave bearing face having a portion extending below said pivot axis and interfitting with that portion of said front convex wall which extends below said pivot axis when said leg is in said normal position, said rear bearing-head wall being also convex and being also longitudinally concentric with said pivot axis, said hook-stop being fixed to the upper end of said rear bearing-head wall and engaging the lower end of said rear thigh-wall when said leg is in said normal selected position, the longitudinal curvature of said rear convex bearing-head wall being greater than the longitudinal curvature of said front convex bearing-head wall.

5. A simulated limb which has a thigh member and a leg member which have a joint at their adjacent ends; said leg member being longitudinally turnable in said joint relative to said thigh about a pivot joint axis which is transverse relative to said thigh and leg; said leg being thus turnable counterclockwise about said pivot axis to a normal selected position and being thus turnable clockwise about said pivot axis out of said normal selected position, said thigh having a front thigh-wall and a rear thigh-wall; said leg having a front leg-wall and a rear leg-wall; said front thigh-wall having a front socket-extension in said joint which extends below the lower

end of said rear thigh-wall; said socket-extension having an inner concave bearing face which is longitudinally concentric with said pivot axis in said turning directions; said leg having a bearing-head in said joint; said bearing-head having a front convex bearing-head wall which turnably interfits with said concave bearing face; said bearing-head having a rear bearing-head wall which has a hook-stop; said hook-stop being located to engage said thigh when said leg is in said normal position; said hook stop being moved out of engagement with said thigh when said leg is turned clockwise out of said selected normal position; said concave bearing face having a portion extending below said pivot axis and interfitting with that portion of said front convex wall which extends below said pivot axis when said leg is in said normal position, and a tension spring located in said limb and shiftably connected to said thigh and leg, said tension spring being located to exert a counterclockwise torque on said leg when said leg is in said normal selected position, said spring being shifted and located to exert a clockwise torque when said leg is turned clockwise to an intermediate angular position, said leg being turnable clockwise beyond said intermediate angular position.

6. A simulated limb which has a thigh member and a leg member which have a joint at their adjacent ends; said leg member being longitudinally turnable in said joint relative to said thigh about a pivot joint axis which is transverse relative to said thigh and legs; said leg being thus turnable counterclockwise about said pivot axis to a normal selected position and being thus turnable clockwise about said pivot axis out of said normal selected position, said thigh having a front thigh-wall and a rear thigh-wall; said leg having a front leg-wall and a rear leg-wall; said front thigh-wall having a front socket-extension in said joint which extends below the lower end of said rear thigh-wall; said socket-extension having an inner concave bearing face which is longitudinally concentric with said pivot axis in said turning directions; said leg having a bearing-head in said joint; said bearing-head having a front convex bearing-head wall which turnably interfits with said concave bearing face; said bearing-head having a rear bearing-head wall which has a hook-stop; said hook-stop being located to engage said thigh when said leg is in said normal position; said hook stop being moved out of engagement with said thigh when said leg is turned clockwise out of said selected normal position; said concave bearing face having a portion extending below said pivot axis and interfitting with that portion of said front convex wall which extends below said pivot axis when said leg is in said normal position, a link which is located in said thigh and in said joint, the upper end of said link being turnably connected to said thigh to turn around an upper transverse axis which is located above said pivot axis, said link having a link-loop in said joint, a tension spring, the upper end of said tension spring having a spring-loop which slidably engages said link-loop, the lower end of said spring being connected to said leg at its front leg-wall, said spring being located to exert a counterclockwise torque on said leg when said leg is in said normal selected position, said link being located to be engaged by said rear bearing-head wall when said leg is turned clockwise to an intermediate inclined position beyond which said leg is clockwise turnable, said rear-bearing head wall engaging said link to turn said link counterclockwise around its upper transverse axis when said leg is turned clockwise beyond said intermediate position.

7. A simulated limb which has a hollow thigh member and a hollow leg member which have a joint at their adjacent ends; said leg being longitudinally turnable in said joint relative to said thigh about a pivot joint axis which is transverse relative to said members; said thigh having an inner lateral thigh-rod fixed thereto above said joint; said leg having an inner lateral leg-rod fixed thereto below said joint, said thigh having a front thigh-wall and a rear thigh-wall, said leg having a front leg-wall and a rear leg-wall, said leg-rod being upwardly and forwardly inclined, said front thigh-wall having a front socket-extension in said joint which extends below the lower end of said rear thigh-wall, said socket extension having an inner concave bearing face which is longitudinally concentric with said pivot joint axis and which has a non-circular lateral cross-section; said leg having a bearing-head in said joint, said bearing-head having a front convex bearing-head wall which interfits with said concave bearing face, said bearing-head having a rear convex bearing-head wall of greater longitudinal curvature than said front-bearing head; a link which has an upper end which is pivotally connected to said thigh-rod to turn about a link axis which is parallel to said pivot joint axis, said link having a link-loop in said joint at the lower end of said link, a tension spring, said tension spring having an upper spring-loop which slidably engages said link-loop, said tension spring having a lower spring-loop which slidably engages said leg-rod, said rear bearing head-wall having a hook-stop at its upper end, said leg being turnable counterclockwise about said pivot joint axis to a normal position in which said hook-stop engages the bottom end of said rear thigh-wall to prevent further counterclockwise turning movement of said leg, said spring being located to exert a counterclockwise torque on said leg when said leg is in said normal position, said leg being turnable about said pivot joint axis in a clockwise direction to an intermediate inclined position and to a final inclined position, said link being turned clockwise around said link axis when said leg is turned to said intermediate position, said spring being located to exert a clockwise torque on said leg when said leg is in said intermediate position, said rear bearing-head wall being located to abut said link and to turn said link counterclockwise around its link-axis when said leg is turned clockwise from said intermediate inclined position to said final inclined position, said spring being substantially alined with said pivot joint axis when said leg is in said final inclined position.

8. A simulated hollow limb which has a longitudinal axis, said simulated limb having a hollow upper limb-member and a hollow lower limb member which are turnable relative to each other in a common joint around a pivot axis which is transverse relative to said longitudinal axis, said upper limb member having a front wall and a rear wall, said rear wall of said upper member having a bottom edge in said joint, said front wall of said upper member having a concavo-convex extension which extends below said bottom edge of said rear wall of said upper member, said concavo-convex extension having a concave inner face, said lower member having a front convex wall which interfits in said joint turnably with the concave inner face of said concavo-convex extension when said lower member is aligned with said upper member and also when said lower member is substantially perpendicular to said upper member, said lower member having a rear wall in said joint, said rear wall of said lower member being convex and having a rearwardly projecting abutment means provided adjacent its upper edge, said rear wall of the upper member having an inwardly extending projection on its bottom edge against which the abutment means is adapted to strike to arrest the counterclockwise movement of the lower member and position the lower member in normal position of alignment with the upper member, said rear wall of the lower member having a shoulder junction with the adjacent part of said lower member at the lower edge of said convex rear wall of said lower member, said shoulder junction being located to contact with said bottom edge of said rear wall of said upper member when said lower

member is turned backward in said joint relative to said upper member.

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