DOLL HAVING AN ANGULARLY ADJUSTABLE LIMB

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In general, the present invention relates to a doll limb, such as a leg or arm, and a doll having such limb. More particularly, the present invention relates to a simply formed, life-like doll limb which is adapted to reproduce the natural movements and contours of a human limb and yet maintain a selected position. Although this invention is described with reference to "doll limbs" and "human limbs," it is equally applicable to any artificial or toy animal limb. Consequently, such phrases are defined by applicant to include any animal limb, although the invention is particularly applicable to human limbs.

The construction of dolls is a very old art wherein a wide variety of forms, devices and methods have been employed. The earlier forms of doll constructions normally utilized rigid limbs and this could obtain reasonably accurate reproductions of the normal human limbs, but could not reproduce movement of the limbs, i.e., arms and legs. Later, in order to simulate the movement of human limbs, doll limbs were made having knee joints or elbow joints. However, in order to obtain such movable limbs the natural contours of the limb had to be sacrificed. Also, whether the limb was movable or rigid the normal usual doll limb lacked the flexibility and resiliency of the normal human limb. Furthermore, the usual doll limb, particularly if it was movable, was relatively complicated in structure and expensive to manufacture and could not normally maintain a selected position in the usual course of handling.

Consequently, an object of the present invention is a simply formed life-like doll limb.

Another object of the present invention is a doll limb adapted to reproduce the natural movements and contours of a human limb and yet maintain a selected position.

Still another object of the present invention is a doll limb adapted to permit the doll to cross its legs and be seated while maintaining the natural contours and limb positions.

Another object of the present invention is a doll limb whose connection between the torso and limbs is adapted to achieve side and rear angular displacement of the limbs.

Still another object of the present invention is a doll limb whose connection between its upper and lower parts is adapted to achieve side and rear angular displacement of the lower part.

Other objects and advantages of the present invention will be readily apparent from the following description and drawings which illustrate a preferred exemplary embodiment of the present invention.

In general, the present invention involves a doll limb comprising a lower shaft, an upper shaft adapted to be rotatably connected to the doll torso at its upper end, and a pivot connection between the upper end of the lower shaft and the lower end of the upper shaft. Such pivot connection is adapted to permit the rotation of the lower shaft with respect to the upper shaft within a predetermined range and to maintain selected positions of the lower shaft. The shafts are permanently embedded in the central portion of a solid elastic body shaped in the form of a human limb so that the natural movement and contours of the human limb may be reproduced.

In order to facilitate the understanding of the present invention, reference will now be made to the appended drawings of several specific embodiments of the present invention. Such drawings should not be construed as limiting the invention which is properly set forth in the appended claims.

In the drawings:

FIG. 1 is a perspective view of a doll having legs embodying the present invention.

FIG. 2 is a partially broken-away perspective view of the doll leg illustrated in FIG. 1.

FIG. 3 is an exploded perspective view of the doll leg illustrated in FIG. 2.

FIG. 4 is a cross-sectional view of FIG. 3 taken along line 4—4 of FIG. 3.

FIG. 5 is a cross-sectional view of FIG. 4 taken along line 5—5 of FIG. 4.

FIG. 6 is an exploded perspective view of FIG. 4.

FIG. 7 is an enlarged detail of FIG. 6 showing one of the rack teeth in cross-section.

FIG. 8 is a perspective view of a doll having legs incorporating another embodiment of the present invention.

FIG. 9 is a partially broken-away exploded perspective view of the doll leg illustrated in FIG. 8.

FIG. 10 is a cross-sectional view of FIG. 8 taken along line 10—10 of FIG. 8.

FIG. 11 is a cross-sectional view of FIG. 9 taken along line 11—11 of FIG. 9.

FIG. 12 is an exploded perspective view of the rack portion of FIG. 11.

FIG. 13 is a cross-sectional view of FIG. 11 taken along line 13—13 of FIG. 11.

FIG. 14 is a side view of FIG. 11 taken along line 14—14 of FIG. 11.

FIG. 15 is a partially exploded perspective view of the armature portion of a doll limb of the present invention similar to FIG. 9.

FIG. 16 is a first view of the limb armature shown in FIG. 15.

FIG. 17 is a cross-sectional view of the hip portion of a doll similar to FIG. 8.

FIG. 18 is a cross-sectional view of FIG. 16 taken along line 18—18 of FIG. 16.

FIG. 19 is an exploded perspective view of a portion of the pivot connection portion of FIG. 16.

FIG. 20 is a side view of a doll limb in a bent position incorporating the limb armature shown in FIG. 16.

FIG. 21 is a top view of the doll limb shown in FIG. 20.

FIG. 22 is a front view of a doll whose limbs incorporate the limb armature shown in FIG. 16 and is seated with its legs crossed.

As illustrated in FIGS. 1—7, the doll limb of the present invention involves a leg 10 mounted on a doll torso 11 by means of a hook 12 attached to the upper end of the leg 10 and a rubber connector 13 which is engaged by the hook 12. The leg 10 includes an armature having a lower shaft 20 having a substantially X-shaped cross-section. The lower shaft 20 taps at its lower end 21 and
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has formed therein a downwardly facing socket 23. Also, the armature has an upper shaft 30 having a substantially T-shaped cross-section with a bowl 31 formed on its upper end having its opening 31 toward the doll torso 11. The bowl 32 also includes a hole 33 through which the hook 12 may be inserted.

Between the upper end 24 of the lower shaft 20 and the lower end 24 of the upper shaft 30 is a pivot connection 40. The pivot connection 40 comprises a circular rack 41 on the upper end 24 of the lower shaft 20 and a circular rack 42 on the lower end 34 of the upper shaft 30. The racks 41 and 42 are adapted to be mutually engaged and disengaged by their relative rotation. Preferably, the rack teeth are tapered at an angle of about 20° from the vertical as illustrated in FIG. 7. Rotatably inserted through the racks 41 and 42 is a pivot pin 43 having an enlarged head 44 and an enlarged base 45 so as to permanently connect the lower shaft 20 to the upper shaft 30. Mounted on the pivot pin 43 is a spring washer 46 which seats against the pivot pin head 44 and exerts pressure on the upper end 24 of the lower shaft and thus in turn causes a corresponding pressure in the opposite direction on the lower end 34 of the upper shaft 30 by the base 45. The spring washer 46 thus forces the racks 41 and 42 into mutual engagement, but because of its flexibility permits their disengagement by the application of sufficient rotational force on one of said racks relative to the other of said racks. In addition, flat washers 47 may be inserted between the pivot pin 43 and the outer surfaces of the racks 41 and 42 to protect them.

The pivot connection 40 also includes stops on at least one of the shafts 20 and 30. As illustrated in FIGS. 4-6, the lower shaft 20 has a first stop 48 and a second stop 49 set on opposite sides of a circular recess 50 in the rack 41 adapted to limit the rotation of the lower shaft 20 in a first or forward direction and a rear or second direction. The upper shaft 30 has a first stop 51 and a second stop 52 set on opposite sides of a circular projection 53 on the rack 42 adapted to limit the rotation of the lower shaft 20 in a forward direction and a rearward direction. Such positioning of said stops is adapted to permit the leg to rotate in a normal range for the natural human leg. Also, the stops 51 and 52 of the rack 42 are slidably fitted into the recess 50 of the rack 41 so that the operation of the stops is protected from external interference. In addition, the stops have straight sides to insure uniform mutual contact.

The upper shaft 30 and the lower shaft 20 are permanently embedded in the central portion 61 of a solid elastic body 60 so that the natural movements and contours of the human limb may be reproduced. The elastic body 60 has a hole 62 therein corresponding to the opening of the socket 23 in foot part 22 of shaft 20 so that the leg 10 may be mounted on a peg 64, if desired, as illustrated in FIG. 1. Similarly, the elastic body 60 has an aperture 63 therein corresponding to the opening 32 of the bowl 31 of the upper shaft 30 so that the limb 10 may be connected to the doll torso by means of the hook 12 and rubber connector 13.

The doll limb of the present invention may be simply formed by connecting the lower shaft 20 and the upper shaft 30 by means of the pivot connection 40. Such construction may then be mounted in a mold in the central portion of a mold and the elastic body 60 formed thereabout by a molding process, such as injection molding. The elastic body may be formed out of a soft plastic, such as a polyvinyl plastisol, including polyvinyl chloride, dioctyl phthalate and other conventional materials, such as fillers and extenders, e.g., soybean oil, calcium carbonate, a stabilizer and a pigment. The shafts and racks may also be formed out of plastic, while the pivot pin and washers are preferably made out of metal.

In FIGS. 8-14, another specific embodiment of the present invention is illustrated wherein each leg 110 is mounted on the doll torso 111 by means of a conical boss 112 formed on the upper end 122 of the upper shaft 130 embedded in the leg 110. The boss 112 is inserted into an aperture 113 in the torso 111 with its inwardly tapered end 112' toward the doll torso 111 until its shoulder 114 engages the torso 111. Such engagement is achieved by the initial compression of the boss 112 during insertion and then its expansion when the shoulder 114 slips past the wall of the torso 111. (See FIG. 10). Also, as shown, the shoulder 114 tapers away from the doll torso 111 so that a wide variation in the thickness of the torso wall 111' can be accommodated in the space between the shoulder 114 and the upper end 122 and still maintain a snug fit.

The leg 110 includes a lower shaft 120 formed from a member 121 with a tapered lower end 122. Similarly, the leg 110 has an upper shaft 130 having a substantially flat piece 131 having the boss 112 molded to its upper end 132 and may include an offset ridge 133. Preferably, both the upper shaft 130 and the lower shaft 120 have extending prongs 134 and 123, respectively, to promote an intimate union between the shafts 130 and 120 and the elastic body 60. In addition, the upper shaft 130 may include a plurality of holes 135 therethrough to insure a permanent connection between the upper shaft 130 and the elastic body 60 by the elastic body 60 extending thereinto.

Between the upper end 124 of the lower shaft 120 and the lower end 136 of the upper shaft 130 is a pivot connection 140. The pivot connection 140 includes a circular rack 141 on the upper end 124 of the lower shaft 120 and a circular rack 142 on the lower end 136 of the upper shaft 130. The racks 141 and 142 are rotatably connected and adapted to be mutually engaged and disengaged by their relative rotation. Unlike the pivot ring arrangement discussed above, the rotatable connection between the racks 141 and 142 involves a projection from one of said racks inserted into a mating recess in the other of said racks. More specifically, a projection 143 is mounted on the rack 142 and slidably inserted into the mating recess 144 in the rack 141.

The pivot connection 140 also includes spring means for forcing the racks 141 and 142 into mutual engagement while permitting their disengagement by the application of sufficient rotational force thereto. However, unlike the spring washer arrangement discussed above, the spring means comprises a spring clip 145 with a first loop 146 around the outer side of the rack 142 and a second loop 147 around the outer side of the rack 141 so that the remote ends of the racks are connected together. The pivot connection 140 also includes stops on at least one of the shafts 120 and 130. As illustrated in FIGS. 11-14, the lower shaft 120 has a first stop 148 and a second stop 149 set on opposite sides of a circular recess 150 in the rack 141 adapted to limit the rotation of the lower shaft 120 in a first or forward direction and a rear or second direction. The upper shaft 130 has a first stop 151 and a second stop 152 set on opposite sides of a circular recess 153 in the rack 142 adapted to limit the rotation of the lower shaft 120 in a forward direction and a rearward direction. Such positioning of said toys is adapted to permit the leg to rotate in a normal range for the natural human leg. Also, the operation of the stops is protected from external interference such as molding of the elastic body 60 onto the shafts 120 and 130. In addition, the stops have straight sides to insure uniform mutual contact. The upper shaft 130 and lower shaft 120 are permanently embedded in the central portion 61 of a solid elastic body 60 so that not only the natural movements but also the natural contours of the human limb may be reproduced.

In FIGS. 15-22, still another specific embodiment of the present invention is illustrated which is also the preferred embodiment of the present invention. As shown therein, each leg 210 is mounted on the doll torso 211.
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by means of a conical boss 212 formed on the upper end 232 of the upper shaft 230 embedded in the leg 210. The boss 212 is inserted in an aperture 213 in the torso 211 with its inwardly tapered end 212' toward the doll torso 211 until its shoulder 214 engages the torso 211. As set forth above, the shoulder 214 tapers away from the doll torso 211 so that the angle of the torso wall 211' can be accommodated in the space between the shoulder 214 and the upper end 232 of the armature 215.

The armature 215 of the leg 210 includes a lower shaft 220 formed from a strut 221 with a tapered lower end 222. Similarly, the armature 215 of the rotational member of the torso wall 211' can be accommodated in the space between the shoulder 214 and the upper end 232 of the armature 215.

The side walls 211' of the torso 211 to which the leg 210 is attached taper inwardly toward the front of the doll. Thus, the axis of rotation of the boss 212 formed in the upper end of the shaft 230 by which the leg 210 is secured to the torso 211 is an axis of rotation of the leg in the range of about 10° to 15°, which is the corresponding angle. Such an angle of forward inclination of the axis of rotation of the connection is adapted to cooperate in permitting the doll to cross its legs when in a seated position. The angle of forward inclination may be in the range of about 6° to 10° but, as illustrated, the angle is preferably about 8°.

Between the upper end 225 of the lower shaft 220 and the lower end 235 of the upper shaft 230 is a pivot connection 240. The pivot connection 240 includes a circular rack 241 on the upper end 225 of the lower shaft 220 and a circular rack 242 in the lower end 235 of the upper shaft 230. The racks 241 and 242 are rotatably connected and adapted to be mutually engaged and disengaged by their relative rotation. Similar to the pivot pin arrangement shown in FIGS. 10-14, the rotatable connection between the racks 241 and 242 involves a projection 243 from the rack 241 which is inserted into a corresponding recess 244 in the rack 242.

The pivot connection 240 also includes a spring means 245 for not only forcing the racks 241 and 242 into mutual engagement while permitting their disengagement by the application of sufficient rotational force thereto, but also is adapted to prevent the racks from assuming a stable, disengaged position. In addition, the spring means 243 is adapted to adjust to the various angles of inclination and tilting, as discussed below. The spring means 245 comprises a fastener 246 with a crossbar 248 with a first finger 247 extending therefrom. The first finger 247 includes a loop 248 positioned around a ridge 256 on the outer side of the lower end 235 of the upper shaft 230. The crossbar 246 has a second finger 249 which terminates in a contact point 250. The loop 248 of the first finger 247 bears against the outer side of the rack 242, while the contact point 250 of the second finger 249 bears against the outer side of the rack 241. The rack 241 is secured to the torso 211, to which the boss 212 is attached, and the rack 242 is secured to the lower shaft 220 so that the bosses are forced into mutual engagement. In addition, the loop 248 and contact point 250 form an effective three-point connection so that when the racks 241 and 242 are disengaged the contact point 250 is disconnected from the torso 211, and the bosses are forced against each other and force them into engagement. Finally, the clip 245 has ears 247' and 249' extending upwardly from their corresponding fingers 247 and 249. The ears 247' and 249' are adapted to contact the prows 233 on the upper shaft 230 and thus maintain the position of the clip 245 on the armature 215.

The pivot connection 240 also includes stops on the shafts 220 and 230. As illustrated in FIGS. 18 and 19, the lower shaft 220 has its stop formed out of the projection 243 which is slidably received in the recess 244 of the upper shaft 230. The second stop 237 is set in the side of the recess 244 of the upper shaft 230 and is adapted to limit the rotation of the lower shaft 220 in a first or forward direction and a rear or second direction. As illustrated in FIG. 20, the stops are adapted to limit the rearward bending of the leg to an angle of about 10° from horizontal in order to facilitate the crossing of the doll legs. Also, as noted above, the operation of the stops is protected from external interference, such as molding of the elastic body 60 onto the armature 215 and have straight sides to insure uniform mutual contact. In addition, the armature 215 is permanently embedded in the center of a solid elastic body 60 so that not only the natural movement, but also the natural contours of the human limb may be reproduced.

As shown in FIGS. 15 and 16 particularly, the axis 251 of the pivot connection 240 is angularly displaced from being perpendicular to a plane bisecting the doll torso. Consequently, as illustrated in FIG. 21 the leg 210 on being bent extends toward such bisecting plane. More particularly, as shown in FIG. 16, the axis 251 of the pivot connection 240 is vertically tilted with reference to the bisecting plane of the torso. Such vertical tilt may be an angle in the range of about 10° to 20°, but preferably, as illustrated, the angle is about 15°. With such tilt angle to the axis of the pivot connection, the lower portion of the leg when bent to the rear will also bend in a corresponding angle, as illustrated in FIG. 21. Therefore, when the upper portions of both legs are bent forward while the lower portions are bent to the rear, the resulting effect is to achieve a seated position with the legs crossed, as illustrated in FIG. 22.

In addition to the vertical tilt of the axis 251 of the pivot connection 240, the axis 251 also has a rearward inclination adapted to substantially offset the forward inclination of the torso connection. Such rearward inclination is shown in FIG. 16 and indicated in FIG. 17. Such rearward inclination of the pivot connection 240 permits the leg 210 to assume a normal orientation with respect to the torso, although the forward inclination of the connection between the leg and the torso causes the leg to be inclined inwardly when the upper portion of the leg is rotated in a forward direction.

Many other specific embodiments of the present invention will be obvious to one skilled in the art in view of this disclosure. For example, although the invention has been illustrated with respect to a doll leg, it is apparent that a doll arm may be constructed in a similar fashion a similar fashion. Also, the configuration of the upper and lower shafts may be changed, depending on the specific doll construction desired. As shown, the socket in the lower shaft may be eliminated or the bowl in the upper shaft may be changed to another shape, depending on the particular joint which is utilized to connect the arm or leg to the doll torso.

In addition, although as shown the axis of the pivot connection between the upper and lower shafts is bent through a compound angle, i.e., vertically tilted and rearwardly inclined, it may be bent through a simple angle to achieve the same results, i.e., only rearwardly inclined but through a greater angle. However, such simple angle does not achieve as graceful a form, e.g., tends to produce a thicker knee, so the compound angle is preferred. Also, the pivot connection itself may be formed out of circular serrations or merely a rough friction surface. Such arrangements do not maintain the leg portion as well and tend to wear out rapidly.

There are many features of the present invention which clearly show the significant advance the present invention represents over the prior art. Consequently, only a few of the more outstanding features will be pointed out to illustrate the unexpected and unusual results attained by the present invention. One feature of the present invention is a doll limb which is simply formed and life-like.
in structure and movement. Thus, the doll limb of the present invention is adapted to reproduce the natural movements and contours of a human limb. For example, as the leg is bent the front portions of the elastic body are stretched and the rear portions of the elastic body are contracted in a fashion similar to the bending of a natural limb. Likewise, when the leg is squeezed it will resiliently yield to an extent similar to the flesh on a human limb and yet present the resistance similar to the main bone of the natural human arm or leg. Also, the construction of the lower and upper shafts and their pivot connection and placement in the elastic body permits the elastic body to be shaped in the form of a human limb. Another feature of the present invention is a doll limb adapted to maintain a selected position. Thus, when the circular racks of the pivot connection are mutually engaged the doll limb will maintain such position until a substantial rotational force is applied to either the upper or lower shaft compared relative to the other shaft. Consequently, the doll may be set in a wide variety of positions, if desired, and such positions will be maintained while the doll is handled and in use. Still another feature of the present invention is a doll limb which is adapted to rotate in a manner similar to a human limb over the normal range of rotation of a human limb. Thus, by appropriate placement of stops on either the upper or lower shaft, or both, the contact of such stops with the other shaft determines both the forward and rear movement of the lower portion of the limb with respect to the upper portion of the limb.

Still another feature of the present invention is the inclining of the legs with respect to the torso and the angling of the pivot connection between the upper and lower leg portions so that the doll can assume a normal standing position with the legs in a natural orientation with respect to the torso and yet can also assume a normal seated position with its legs crossed. Still another feature of the present invention is a spring means for the pivot connection between the upper and lower leg portions which permits the bending of the legs but prevents the circular racks of the pivot connection from forming a stable, disengaged position.

It will be understood that the foregoing description and examples are only illustrative of the present invention and it is not intended that the invention be limited thereto. All substitutions, alterations and modifications of the present invention which come within the scope of the following claims or to which the present invention is readily susceptible without departing from the spirit and scope of this disclosure are considered part of the present invention.

I claim:

1. A simply formed life-like doll limb adapted to reproduce the natural movements and contours of a human limb and yet maintain a selected position comprising:
   (a) a lower shaft;
   (b) an upper shaft having means at its upper end defining a pivotal hip joint about which it is adapted to be rotatably connected to a doll torso,
   (c) a pivot connecting the upper end of said lower shaft and the lower end of said upper shaft to define a limb joint, said pivot connection including stop means to limit rotation of said lower shaft with respect to said upper shaft to a predetermined range, and means to releasably maintain said lower shaft in selected pivoted positions; and
   (d) a solid elastic body shaped in the form of a human limb and having said upper shaft, lower shaft and limb joint permanently embedded in its central portion so that the natural movements and contours of said human limb may be reproduced, said stop means being substantially enclosed by portions of said pivot connection and thus free of engagement with said elastic body.

2. A doll limb as stated in claim 1 wherein said upper shaft has a bowl formed on its upper end facing toward said doll torso and said elastic body has a recess therein receiving said bowl, said bowl defining the inner surface of said recess to comprise a bearing surface.

3. A doll limb as stated in claim 1 wherein said upper shaft has a conical boss formed on its upper end tapering inwardly toward said doll torso and having a shoulder adapted to engage said doll torso when inserted therein, said boss projecting outwardly of said elastic body.

4. A doll limb as stated in claim 1 wherein said hip joint defines a first axis and wherein the axis of said pivot connection is angularly displaced from said first axis in a plane transverse to said limb.

5. A doll limb as stated in claim 4 wherein the axis of said pivot connection is also vertically tilted with reference to said first axis.

6. A doll limb as stated in claim 5 wherein the axis of said pivot connection is vertically tilted to an angle in the range of about 10° to 20°.

7. A doll limb as stated in claim 1 wherein said pivot connection comprises:
   (a) a circular rack on the upper end of said lower shaft;
   (b) a circular rack on the lower end of said upper shaft, said racks being rotatably connected and relatively movable along their axis of rotation and adapted to be mutually engaged and disengaged by the rotation; and
   (c) spring means for forcing said racks axially into mutual engagement while permitting their disengagement by the application of sufficient rotational force thereto.

8. A doll limb as stated in claim 7 wherein said racks are rotatably connected by means of a pivot pin inserted therethrough and said spring means comprises a spring washer mounted on said pivot pin.

9. A doll limb as stated in claim 7 wherein said racks are rotatably connected by a projection from one of said racks inserted into a mating recess in the other of said racks and said spring means comprises a spring clip connecting the adjacent ends of said racks.

10. A doll limb as stated in claim 9 wherein said spring clip has a finger making point contact with the adjacent rack end.

11. A doll limb as stated in claim 1 wherein said stop means comprises a pair of stops on at least one of said shafts, the first stop being adapted to limit the rotation of the lower shaft in the first direction and the second stop being adapted to limit the rotation of the lower shaft in the second direction.

12. A doll limb as stated in claim 11 wherein both of said shafts have a pair of cooperating stops.

13. A doll having simply formed life-like limbs adapted to reproduce the natural movements and contours of a human limb and yet maintain a selected position, comprising:
   (a) a torso;
   (b) an upper shaft rotatably connected to one side of said torso at its upper end and having a single axis of rotation, the outer end of the axis of rotation of said connection being inclined forwardly so as to diverge from an axial plane bisecting the doll between its hips;
   (c) a lower shaft;
   (d) pivot means forming a connection between the upper end of said lower shaft and the lower end of said upper shaft, said pivot means being adapted to permit rotation of said lower shaft with respect to said upper shaft within a predetermined range and to maintain selected positions of said lower shaft; and
   (e) a solid self-contained elastic body shaped in the form of a human limb and having said upper shaft and lower shaft permanently embedded in its central portion so that the natural movements and contours of said human limb may be reproduced.
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14. A doll as stated in claim 13 wherein the angle of forward inclination of said axis of rotation is in the range of about 6° to 10°.

15. A doll as stated in claim 13 wherein the axis of said pivot connection has a rearward inclination adapted to substantially offset the forward inclination of the axis of said torso connection.

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