

1,383,364.

Patented July 5, 1921.

3 SHEETS—SHEET 1.

FIG-2

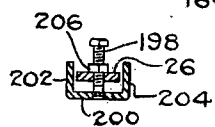
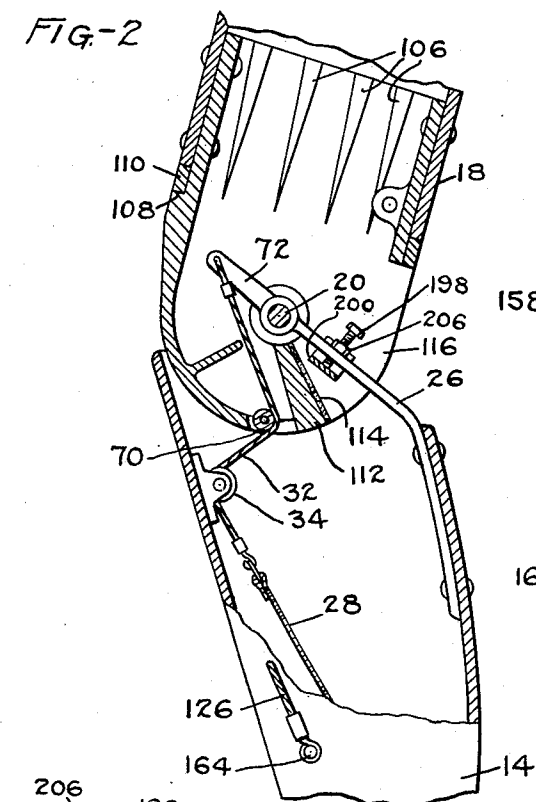


FIG-14

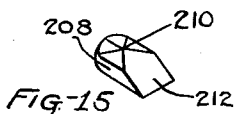


FIG-15

FIG-3

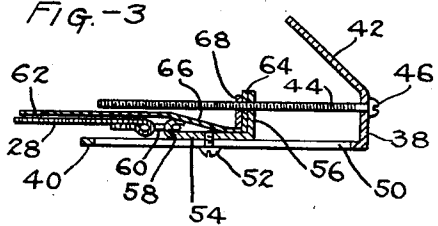


FIG-4

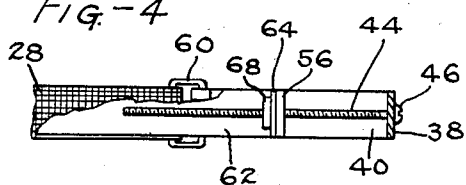
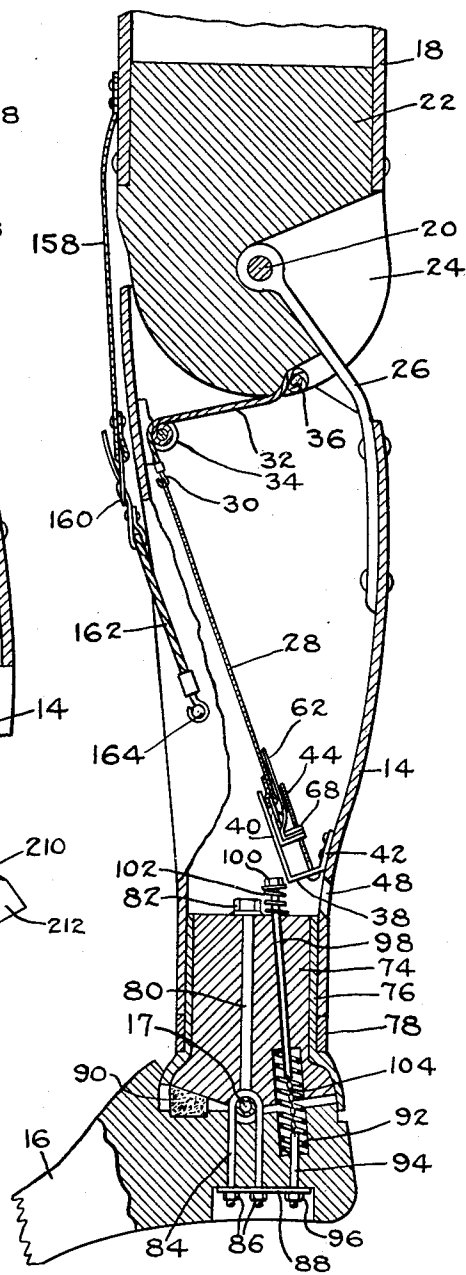


FIG-1



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3 SHEETS—SHEET 2.

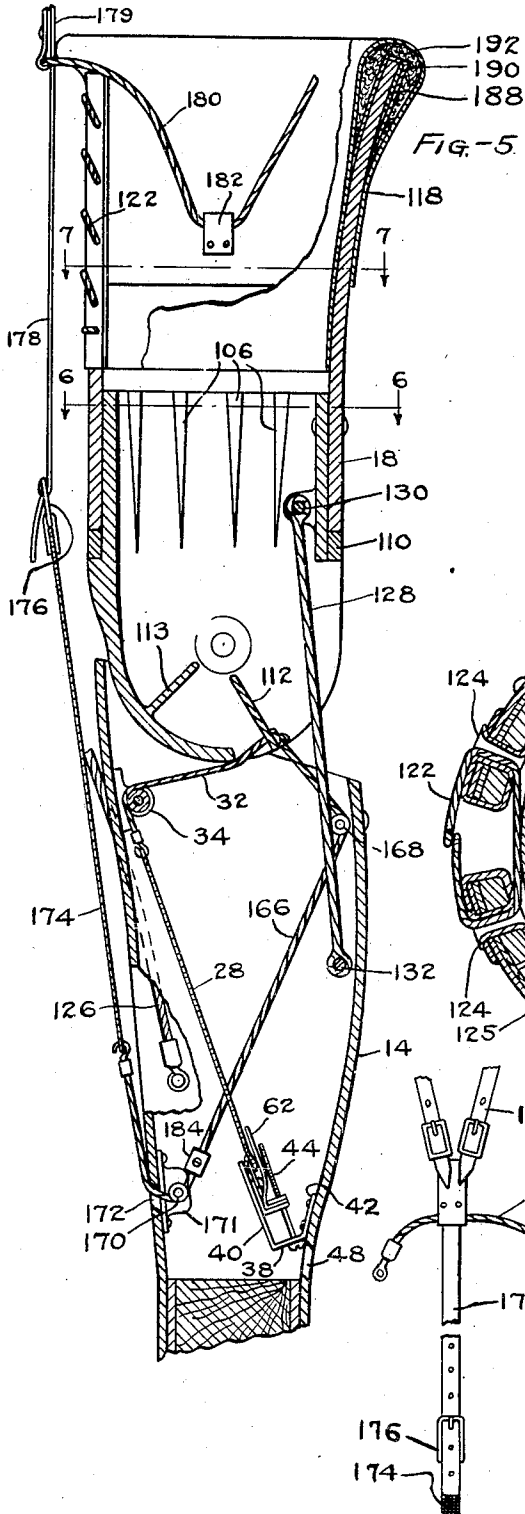


Fig. 5.

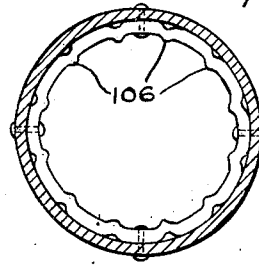


Fig. 6.

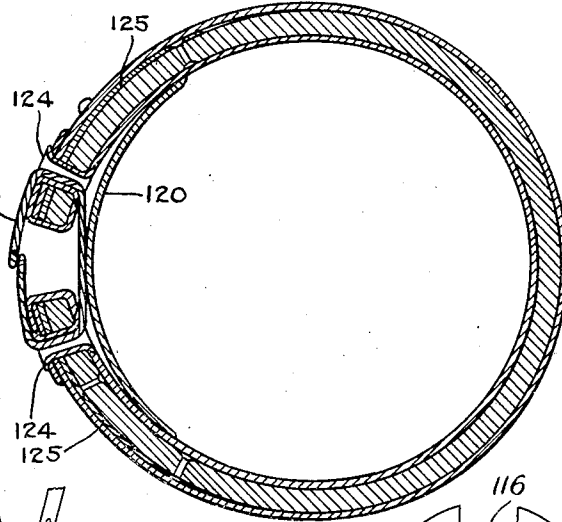


Fig. 7.

Fig. 16.

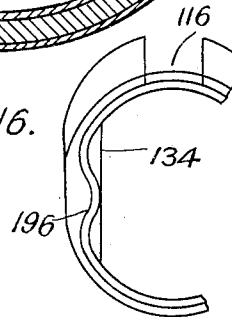
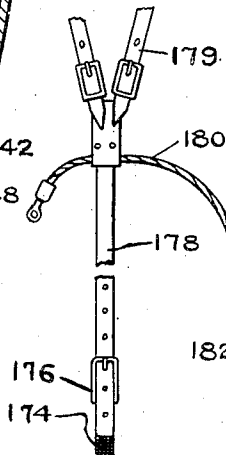


Fig. 5A.

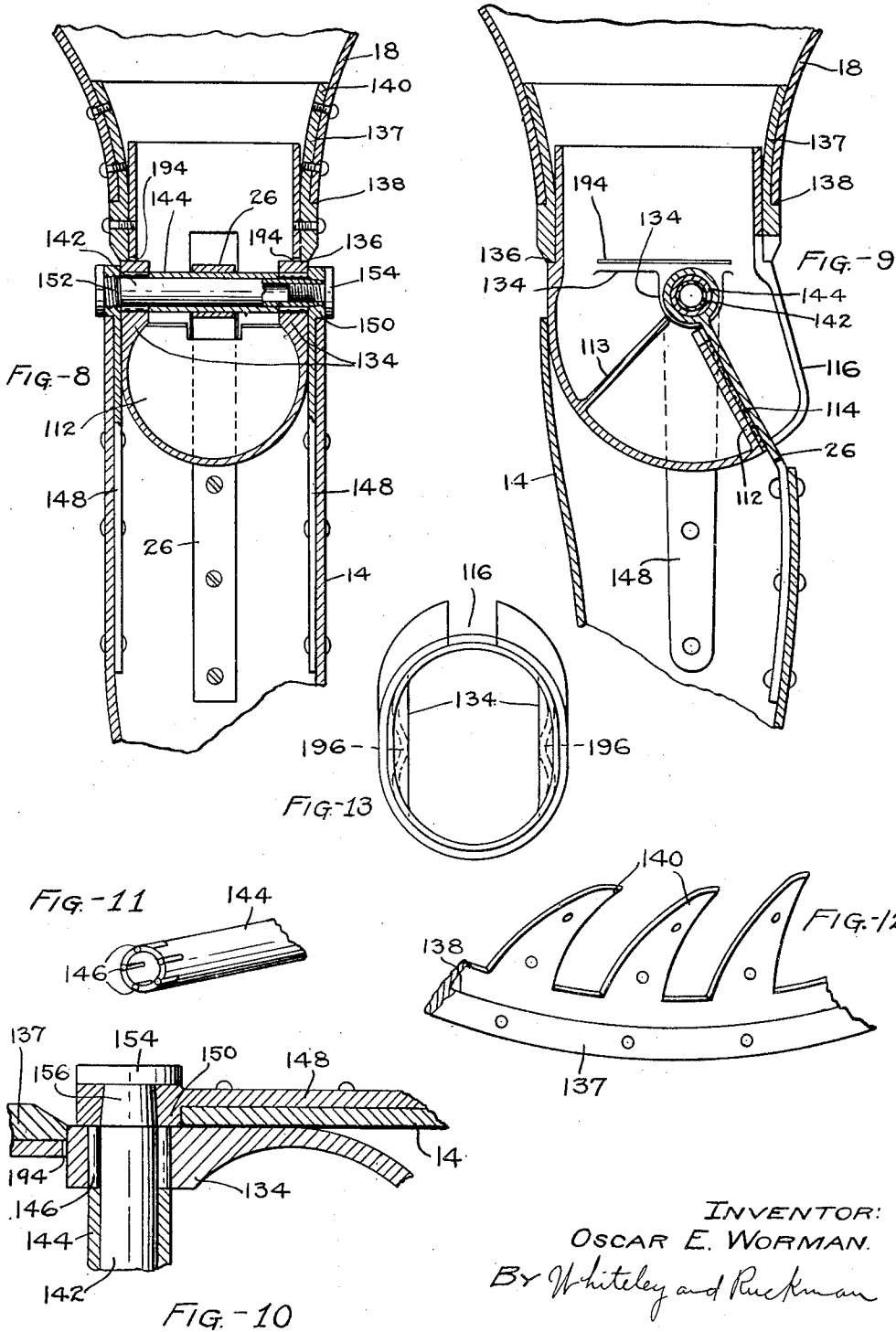


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3 SHEETS—SHEET 3.



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UNITED STATES PATENT OFFICE.

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ARTIFICIAL LIMB.

1,383,364.

Specification of Letters Patent.

Patented July 5, 1921.

Application filed March 8, 1920. Serial No. 364,082.

To all whom it may concern:

Be it known that I, OSCAR E. WORMAN, a citizen of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Artificial Limbs, of which the following is a specification.

My invention relates to artificial limbs and more particularly to artificial limb members for use in cases of amputation above the knee. An object of my invention is to provide an artificial limb which will not only resemble the corresponding human limb in shape, but will function in a manner similar thereto, so that persons who have been crippled by the loss of lower limbs may have their usefulness restored while, at the same time, the handicap in appearance which would otherwise exist is overcome. Another object is to provide an artificial limb which may be readily and economically manufactured and which will insure a maximum degree of comfort to the wearer.

The full objects and advantages of my invention will appear in connection with the following detailed description thereof and the novel features embodied in my inventive idea will be particularly pointed out in the claims.

Referring to the accompanying drawings which illustrate my invention embodied in an artificial limb intended for use more particularly in cases of amputation above the knee,—

Figure 1 is a view substantially in vertical section of upper and lower leg members. Fig. 2 is a view similar to Fig. 1 showing a modified form of construction. Fig. 3 is a detailed view of an adjusting device. Fig. 4 is a view taken at right angles to Fig. 3. Fig. 5 is a view similar to Fig. 2, showing a slight modification and having the upper and lower members shown in their straight position. Fig. 5^A is a front view of suspender connections. Fig. 6 is a view in cross-section on the line 6—6 of Fig. 5. Fig. 7 is a view on an enlarged scale in cross-section on the line 7—7 of Fig. 5. Fig. 8 is a view in vertical section of a modified construction. Fig. 9 is a view in vertical section at right angles to Fig. 8. Fig. 10 is a sectional detail of the knee-bolt joint.

Fig. 11 is a view in perspective of a portion of a fiber bushing. Fig. 12 is a view in perspective of a portion of a securing band. Fig. 13 is a plan view of the hollow knee member. Figs. 14 and 15 are detail views. Fig. 16 is a sectional detailed view of the knee-joint construction. Referring to the particular construction shown in the drawings which illustrate the principle of my invention, and which may be varied in regard to mechanical details without departing from the spirit of the invention, the character 14 designates a shank member having a foot member 16 pivotally connected to the lower end thereof by means of an ankle bolt or cylinder 17. The shank member is pivotally connected by a knee-joint with a thigh member 18 which constitutes a socket limb portion preferably of fiber to receive the stump of the wearer in cases of amputation above the knee. The thigh member is provided at its lower end with a knee-joint member through which a cylinder or bolt 20 extends to make a pivotal connection with the shank member. The knee joint member gives shape and form to the knee portion of the artificial limb and may be constructed of any suitable material. As shown in Fig. 1, the knee-joint member consists of a solid block 22 which is secured in the lower end of the thigh member in any suitable manner as by screws or other fasteners or by means of adhesive material such as glue. The rear side of the block 22 is provided with a slot 24 for receiving a bar 26 attached to and extending upwardly from the shank member and having its upper end extending around the bolt 20 to reinforce and support the same. The bar 26 by its engagement with the knee-block at the bottom of the slot 24, serves as a check or stop for stopping the shank member when the latter swings into a vertical position or the desired position in alinement with the thigh member.

The shank member may be automatically thrown backward by an elastic member so attached to the knee block and passing over a pulley on the front of the shank and attached to the rear of the shank member that when the knee is straightened, the elastic member will be stretched and the shank member when free to move, will be caused

to swing backward into its bent position without effort on the part of the wearer. The elastic member may be attached to the rear lower portion of the shank member so as to obtain a graduated and increased tension as the knee is straightened either for a walking or a standing position of the wearer which makes it possible for the shank member to swing readily and easily into its bent position with the tension gradually decreasing until the shank member comes to a stop in bent position. A convenient form of the device just described is illustrated in Fig. 1 which shows an elastic member 28 secured at its upper end to a hook 30 fastened to one end of a cord 32 running over a roller 34 attached within the upper portion of the shank at the front thereof. The other end of the cord 32 passes into a slot in the lower end of the knee-block and is secured to a pin or rod 36. The lower end of the elastic member is preferably adjustably secured to the shank member in the following manner:—A bracket has an intermediate portion 38 from which extend upwardly a forwardly inclined arm 40 and a rearwardly inclined arm 42, the latter arm being secured to the shank in suitable manner. A screw-threaded bolt 44 extends upwardly through the intermediate portion 38 and the notched head 46 of this bolt may be reached by a tool inserted through an opening 48 in the shank member for the purpose of turning the bolt. The arm 40 is provided with a slot 50 as shown in Fig. 3 through which extends a screw 52 which is threaded into a slidable member 54, the lower end of which is bent at right angles to form the portion 56 which is provided with a hole through which the bolt 44 extends. The upper end of the member 54 is provided with a hook 58 to receive one end of a link 60 which, at its other end, is secured to the lower end of the elastic member 28. A strip 62 has its lower end bent at substantially right angles to form the portion 64 to rest upon the portion 56 while an intermediate portion 66 of the strip is bent so as to engage the end of the hook 58. The portion 64 is provided with a hole through which the bolt 44 extends and a nut 68 placed on top of the portion 64 is screw-threaded to receive the rod 44. The hole in the nut 68 is placed eccentrically so that the nut engages the strip 62 and is prevented from turning. The strip 62, accordingly, has a three-fold function:

1. It prevents turning of the nut 68.
2. It holds the link 60 upon the hook 58.
3. It prevents the elastic member 28 from coming into contact with the rod 44.

In the arrangement shown in Fig. 1, when the shank member is straightened the elastic member 28 will be stretched and when

the shank member is free to move, it will be automatically returned into bent position; in the arrangement shown in Fig. 2, the upper portion of the cord 32 runs over a roller or rounded surface 70 on the lower end of the knee member and the upper end of the cord is attached to an arm 72 which may be an extension of the bar 26. As thus arranged, the elastic member 28 tends to hold the shank member in bent position and when the shank is brought into straight position in walking, as shown in Fig. 5 and the foot is then lifted, the elastic member automatically returns the shank member to its bent position and enables the wearer to more readily swing the leg forwardly for another step, since tendency to drag on the ground is thus avoided. In the arrangements shown in Figs. 2 and 5, as well as in that shown in Fig. 1, the tension of this elastic member is adjusted by turning the bolt 44.

A desirable form of ankle-joint construction is shown in Fig. 1. A block 74 of wood or other suitable material is inserted in a sleeve member 76 of aluminum or other suitable material. This sleeve is adapted to be secured in the lower end of the shank member and in order to provide for inserting the sleeve and block for a variable distance, according to the desired length of limb, a ring 78 may be employed to engage the lower end of the shank member and also a shoulder on the enlarged lower end of the sleeve. By varying the width of this ring, the block may be inserted for variable distances, into the shank member and securely held in place by suitable securing means permitting lengthening or turning of the sleeve for adjusting purposes. A pair of bolts 80 extend up through the block 74 and are provided with nuts 82 at their upper ends. The bolts 80 at their lower ends are provided with the ankle bearing 17 with which a bearing member 84 coöperates, the latter consisting of a U-bolt extending through the foot-member 16 and being secured by nuts 86 engaging a plate washer 88. A buffer 90 is placed between the foot-member and the front beveled portion of the block 74. A spring 92 is placed between the foot-member and the rear portion of the block 74. A bolt 94 provided with a lock nut 96 on its lower end extends part way up inside the lower portion of the spring 92 and a bolt 98 provided with a nut 100 extends part way down inside the upper portion of said spring. A cushion member 102 is placed around the upper portion of the bolt 98 between the block 74 and the nut 100, the latter serving to adjust the tension of the spring 102 and also of the spring 92, and to adjust the position of the foot. The same result may be accomplished by turning the bolt 94 which is threaded through the plate 88. Sudden strain on the

spring 102 is relieved by the buffer 90, when the front of the foot member swings upwardly. The adjacent ends of the bolts 94 and 98 are connected by a short, flexible member 104, such as a chain. Adjustment of the bolt 94 for length may be made by turning same in the threaded portion of plate by means of its notched or angular head. The spring 102 acts as a buffer when the heel portion of the foot member moves into its lowered position upon stepping on the toe portion.

Figs. 2, 5, and 6 illustrate a hollow knee-member of sheet or cast material, preferably aluminum, and this member is adjustable up and down in the thigh member to make the limb longer or shorter as required and may also be turned in the thigh member to adjust for relative position. This knee-member is also adjustable according to the size of the limb and for this purpose, the upper end thereof is provided with a plurality of spaced corrugations 106 so that the diameter can be readily increased or diminished. The knee member is provided with a shoulder 108 while a ring 110 of variable width may be placed between this shoulder and the lower end of the thigh member 18. The width of this ring is varied according to the extent which it is desired to have the knee member extend into the thigh member in order to lengthen or shorten the thigh member. The hollow knee-member is preferably reinforced by ribs or partitions extending across the same, and I have shown a partition 112 extending from side to side, underneath the knee bolt which not only strengthens the knee member, but acts as a bumper for the bar 26, shown in Fig. 2 when the shank member comes into its straight position. For this latter purpose, the partition 112 is given the same inclination as that which the bar 26 has when the shank member is in straight position, and the portion engaged by this bar may be provided with cushioning material 114, of felt or other suitable material. A reinforcing rib 113 for the lower front portion of the knee member is also provided. The knee member is provided with a slot 116 within which the bar 26 may work. The upper portion of the thigh 18 constitutes a socket limb portion preferably of fiber to receive the stump of the wearer, in cases of amputation above the knee. This socket portion may have a covering of leather or other suitable material 118 as shown in Fig. 5. As clearly shown in Fig. 7, the front of the socket portion is provided with a tongue 120 which covers a slot or vertical opening which may be drawn together by a lacing 122 running through eyelets 124, placed along the edges of the opening. As shown in Fig. 7, the front of the socket member may be reinforced with

strips 125 at each side of the vertical slit, these strips having a breaking characteristic which is different from that of the fiber socket. The thigh member may be held up to the body of the wearer in any suitable manner and the shank member may be controlled and brought forward by any suitable form of suspender having connections 126 for attachment to the front portion of the shank member. In Fig. 5, the cord 32 is shown attached to the partition 112 which may be provided with a hole for this purpose through which the cord passes and the end of the cord being provided with an enlargement or knot. In Fig. 5 instead of a bar-check 26, a cord-check 128 of strong material is shown. The upper end of this cord is attached to means of attachment preferably a rod 130 secured within the rear portion of the knee-member and the lower end of the cord is attached to means of attachment preferably a rod 132 which is secured within the rear portion of the shank member.

In the form of invention shown in Figs. 8 to 12, a hollow knee-member preferably of aluminum is provided with bosses or thickened portions 134 on both sides for reinforcing and strengthening the portion adjacent the knee-joint bolt. The knee member is also reinforced by ribs or partitions 112 and 113, similar to those already described and which merge into the bosses 134. The knee-member is preferably provided with a circumferential shoulder 136 upon which may rest a band 137, preferably of aluminum, and having a shoulder 138 upon which the lower end of the thigh member 18 may rest. The lower part of the band 137 may be secured to the knee-member preferably by rivets or screws and the upper part of the band may have portions cut away to form spaced fingers 140 which may be bent so as to fit snugly within the lower end of the thigh and may be secured there-to preferably by means of screws or rivets. A flexible knee check, such as shown in Fig. 5 may be used, but I prefer to use a rigid knee-check 26 such as that shown in Figs. 1 and 2 which coöperates preferably with the bottom of the knee and with the partition 112, which may have the padding 114 to deaden sound. The knee member is constructed to swing on a knee-bolt 142 which is surrounded by a bushing 144 preferably of fiber passing through the bosses 134 on each side and so fitted to the knee bolt as to eliminate friction and wear between the knee bolt and the knee member. The bushing is preferably formed with slits or recesses in the ends thereof to receive preferably cylindrical bearings 146 which engage the bosses or thickened portions 134 and the knee bolt for the purpose of eliminating

friction and wear on the bosses or thickened portions, the bushing and the knee bolt. The knee bolt after passing through the bushing is engaged with side straps 148 attached either within the shank as shown in Figs. 8 and 9 or attached to the outside of the shank as shown in Fig. 10. The side straps may have enlarged portions 150 of sufficient length to rest upon the top of the shank 14 in order to prevent strain on the attaching means for the straps. The enlargements also engage the outside of the bosses or thickened portions so as to cover the bushing and bearings and prevent them from coming out of the knee member as well as to prevent the entrance of dust and foreign substances. The knee bolt is preferably cylindrical and at one end has a head and may have a threaded portion 152 to engage with a threaded portion of one side strap 148 and at the other end may be provided with a screw-threaded member 154 having a head which may be turned up tight upon the other side strap as shown at the right in Fig. 8. As shown in Fig. 10, the knee-bolt at this end is preferably constructed with a tapering portion 156 to engage a similarly tapered portion of the side strap so that this side strap may be wedged and securely held to prevent end shake when the screw threaded member is turned tight. The knee-check at its upper end preferably surrounds the bushing 144 so as to constitute an additional support for the knee bolt as well as to serve as a knee-check, but may also surround the knee-bolt with a bushing on each side coming up to the knee-check. When the knee-check surrounds the bushing, the latter may rotate in the surrounding portion of the knee-check so that an additional bearing is furnished. The base of the band 137 may be varied in thickness and also in height according to the desired size and length of the thigh member.

In addition to the features already described, I may provide an adjustable knee-control to assist in bringing the shank forward in walking. Two forms of knee-control are shown in Figs. 1 and 5, respectively. In Fig. 1, an elastic member 158 is secured at its upper end in any suitable manner to the front lower portion of the thigh member. The lower end of this elastic member is provided with an adjustable connection, such as a strap and buckle connection 160 for attachment to the middle portion of a cord 162 which may be the same as the cord 126, previously mentioned, and the ends of which are attached by fasteners 164 to the shank member, somewhat back from the front thereof at each side. This knee-control attachment is intended for temporary use only until the wearer becomes accustomed to walking when it may be discarded and the customary suspenders passing over

the shoulders may then be attached to the cord 162 and relied upon for bringing the shank forward for another step. It will be noted that the elastic members 28 and 158 correspond to the flexor and extensor muscles, respectively, of the human limb. In the straight line position of the shank shown in Fig. 1, the elastic member 28 is under tension and the elastic member 158 is relaxed. Upon lifting the foot from the ground, the member 28 pulls the shank backward and the momentum acquired will cause the shank to swing back sufficiently to place the member 158 under tension. In this bent position of the shank the member 28 is relaxed and the member 158 is under tension so that the shank is pulled forwardly and the momentum acquired will cause the shank to swing forwardly so that it comes into a straight line position just as the wearer places his foot upon the ground. The member 28 is under tension at this time so that the operation is repeated when the wearer lifts this foot again after having swung the other foot forward in the usual manner of walking.

In the form of knee-control shown in Fig. 5, a flexible member 166 has its upper end attached to the lower portion of the knee-member, as for instance, to the partition 112 when this form of knee is used. The flexible member 166 extends backwardly through a pulley 168 attached to the rear upper portion of the shank and then forwardly and downwardly so as to pass through a pulley 170 mounted in a bracket 171 secured to the inside of the shank. The member 166 passes to the outside of the shank through an opening 172 and this member is positioned inside of the shank so as to pass to the side of the members 28 and 128 and the outer end of the member 166 extends upwardly and is attached to the lower end of an elastic member 174, the upper end of which is preferably adjustably attached by a buckle and strap connection 176 to the lower end of a flexible member 178 depending from the suspenders 179 used for holding the limb to the body of the wearer. Fig. 5^A shows the lower portion of the suspenders looking at them from in front. These suspenders are preferably attached by a loop to a cord 180, the middle portion of which passes through a loop or pulley 182 secured to the outer side of the thigh member in the manner disclosed and claimed in my prior application Serial Number 258,964, filed Oct. 21, 1918. The elastic members 28 and 174 correspond to the flexor and extensor muscles, respectively, and operate in a manner similar to that just described in connection with Fig. 1. The member 166 is provided preferably with an adjustable stop 184 which engages the bracket 171 when the elastic member 174 has pulled the shank

partly forward so that the stop 184 in connection with the suspenders and the connecting members 174 and 178 acts as a lift to complete the forward movement of the shank and thereby avoid undue strain upon the place of attachment to the knee and upon the pulleys 168 and 170. When the wearer sits down, the suspenders relax so that the tension on the elastic member 174 ceases and the elastic member 28 pulls the shank into bent position as is desirable for a sitting position. When the knee-control shown in Fig. 5 is used, the cord connection 126 may be removed as it is not then needed as a means of attachment to the suspenders, and in this way the use of separate suspenders for carrying the limb is avoided.

The upper edge of the thigh member may be constructed as shown in Fig. 5 in order to obtain greater durability of the limb and to insure greater comfort to the wearer. To the upper edge of the thigh member is secured in any suitable manner a reinforcing strip 188 of material such as metal or other material having a breaking characteristic which is different from that of the body portion of the thigh member, the latter being preferably of fiber. Flexible material 190 such as leather is secured over the reinforcing strip and upper edge, and padding material 192 such as soft felt extends over the flexible material 190. A covering of flexible material such as the leather covering 118 previously referred to serves to give a smooth finish and to protect the padding material. The reinforcing strip 188 prevents the upper edge of the thigh member from chipping or breaking and in connection with the padding 192 insures a comfortable contact edge where the human limb engages the top of the artificial limb.

In order that the upper portion of the hollow knee member previously described may be readily inserted within the lower end of the thigh member or within the band 137 when the latter is employed, and after such insertion may be securely fixed in place, said knee member may be provided with one or more indentations adapted to be forced outwardly after the parts have been fitted together. A convenient manner of providing such an indentation is shown in Figs. 8, 9, 10 and 13 in which the numeral 194 designates a cut or slit made in the wall of the knee member preferably in the same plane as shoulder 136 and immediately above the upper edge of the boss or thickened portion 134 or a ledge having its upper edge similarly positioned. If desired a cut of this character may be made at each side of the knee member adjacent the edge just referred to and a short distance above the knee bolt 142. On account of the slit or cut it is an easy matter to indent the material above the same, as indicated in dotted lines at 196 in Fig.

13, which is a plan view of the knee member looking at the same from the top. The material above the slit may be indented without distorting or changing the knee member at the position of the knee bolt and positions below the same. After the upper end of the knee member has been inserted in the lower end of the thigh member these two members may be readily secured together by forcing the indented portion outwardly against the inner wall of the thigh member. In this manner a standard knee member may be used for thigh members of different size at their lower ends. Provision is also made in this way for readily fitting the parts together when the thigh member shrinks and is of less size than originally constructed. By making the cut or slit preferably in the same plane as shoulder 136 and adjacent the upper edge of the boss or thickened portion or ledge 134 it will be apparent from Figs. 8, 10 and 13 that even when the lower end of the thigh member is of such size that the indentation is not restored completely to its original position there will be no downward opening into the interior of the knee member since the boss or thickened portion or ledge forms a closure at the bottom of the indentation.

Figs. 2 and 14 illustrate an adjustable stop by means of which the forward position of the shank member may be adjusted relatively to the thigh member. A screw-bolt 198 extends through a screw-threaded hole in the bar 26 previously described, and a plate 200 is swiveled upon the inner end of this screw-bolt. The plate 200 is provided with flanges 202 and 204 which engage the sides of the bar 26 so that the plate may move back and forth without rotating. A lock nut 206 serves to hold the plate in desired adjusted position. When the shank member swings forward into its straight position it is desirable that it shall pass slightly beyond dead center in order not to yield too readily for a standing position of the wearer. By a slight adjustment of the position of the plate 200 the extent to which the shank is permitted to pass beyond dead center may be readily varied according to the preference of the wearer.

Fig. 15 is a perspective view of a desirable form of construction for the cushion member 90 shown in Fig. 1. This member is made from resilient material such as rubber and the forward end 208 thereof is rounded and the top surface is beveled to form sides of a pyramid having its apex at 210. The rear portion 212 of the cushion member is wedge-shaped, the upper surface of the wedge extending toward the apex of the pyramid. On account of this construction, when the weight of the wearer comes upon the toe portion the cushion is compressed in such manner that a gradually-increasing re-

sistance to further compression occurs, since the compression starts at the apex of the pyramid and is gradually transmitted to the thicker base portion. The wedge shape of the rear portion of the cushion member accommodates the pivotal movement of the foot member relatively to the shank member.

I claim:

1. An artificial limb comprising a shank member and a thigh member pivoted together to form a knee joint, a non-elastic member attached at its upper end to the thigh member, a roller secured within the shank member, said non-elastic member extending over said roller, an elastic member secured at one end to said non-elastic member and secured at its other end to the rear portion of the shank member, and means operable from outside the shank member for adjusting the tension of said elastic member.

2. An artificial limb comprising a shank member and a thigh member pivoted together to form a knee joint, a non-elastic member attached at its upper end to the knee portion of the thigh member, a roller secured within the front portion of the shank member, said non-elastic member extending over said roller, an elastic member secured at one end to said non-elastic member, a bracket secured within the rear portion of the shank member, a slidable member mounted on said bracket, the other end of said elastic member being attached to said slidable member, and means operable from outside the shank member for adjusting the tension of said elastic member.

3. An artificial limb comprising a shank member and a thigh member pivoted together to form a knee-joint, a non-elastic member attached at its upper end to the knee portion of the thigh member, a roller secured within the front portion of the shank member, said non-elastic member extending over said roller, an elastic member secured at one end to said non-elastic member, a bracket secured within the rear portion of the shank member, a slidable member mounted on said bracket, the other end of said elastic member being attached to a hook on said slidable member, said slidable member having an arm, a strip having an arm in contact with said first-mentioned arm, an eccentric nut in contact with said second mentioned arm, and a screw-threaded bolt extending loosely through said bracket and both of said arms and having screw-threaded engagement with said nut, said strip having a body portion which engages said nut and the end of said hook and which is interposed between said elastic member and said screw bolt.

4. An artificial limb comprising a shank member and a foot member pivoted together to form an ankle joint, a block in the lower end of said shank member, a coiled spring

between the rear portions of said block and said foot-member, a rod extending through said foot member, said coil spring and said block, said bolt having an intermediate, flexible portion, a buffer interposed between said block and an enlargement on the upper end of said rod, and a buffer interposed between the front of said block and said foot member.

5. An artificial limb comprising a shank member and a foot-member pivoted together to form an ankle joint, an aluminum sleeve fitted to the lower portion of the shank member, a ring on the outside of said sleeve interposed between the lower end of the shank member and a shoulder on said sleeve whereby the length of the shank member may be varied according to the width of the interposed ring, and a block within said sleeve for carrying the pivotal attachment for the foot member.

6. An artificial limb comprising a shank member, a thigh member, a hollow aluminum knee-member secured to the lower portion of the thigh member, reinforcing partitions within said knee member and secured thereto and a pivotal connection between said knee member and the shank member.

7. An artificial limb comprising a shank member, a thigh member, a hollow aluminum knee member secured to the lower portion of the thigh member, a pivotal connection between said knee member and the shank member, a check member extending between said pivotal connection and the shank member, and a reinforcing partition in said knee member adapted to cooperate with said check member when the shank member is in straight line position.

8. An artificial limb comprising a shank member, a thigh member, a hollow aluminum knee member, thickened portions on the sides of said knee member, and a pivotal connection for the shank member extending through said thickened portions.

9. An artificial limb comprising a shank member, a thigh member, a hollow aluminum knee member secured in the lower portion of the thigh member, thickened portions on the sides of said knee member, reinforcing partitions within said knee member which join the latter with said thickened portions, and a pivotal connection for the shank member, extending through said thickened portions.

10. An artificial limb comprising a shank member, a thigh member, a hollow aluminum knee member, a band attached to said knee-member, extensions carried by said bands, said extensions being adapted to be bent so as to fit snugly within the lower portion of the thigh member, and a pivotal connection between said knee member and the shank member.

11. An artificial limb comprising a shank member; a thigh member, a hollow aluminum knee member secured in the lower portion of the thigh member, a knee bolt extending through said knee member, a fiber bushing surrounding said knee bolt, a plurality of cylindrical bearings mounted in recesses in said bushing where the latter passes through the walls of said knee member; and means for connecting the ends of said knee bolt with the shank member.

12. An artificial limb comprising a shank member; a thigh member, a hollow aluminum knee member secured to the lower portion of the thigh member, a knee bolt extending through said knee member, one end of said knee bolt having a head and adjacent external screw threads, a side strap having a screw threaded hole to cooperate with said screw threads, a second side strap adapted to fit upon the other end of said knee bolt, a screw threaded member having a head adapted to hold said second side strap in place, said screw-threaded member engaging internal threads in said knee bolt, and means for securing both of said side straps to the shank member.

13. An artificial limb comprising a shank member, a thigh member, a hollow aluminum knee member secured to the lower portion of the thigh member, a knee bolt extending through said knee member, one end of said knee bolt having a head and adjacent external screw threads, a side strap having a screw threaded hole to cooperate with said screw threads, a second side strap having a tapered hole adapted to fit upon a corresponding tapered surface at the other end of said knee bolt, a screw threaded member having a head for engaging said second side strap, said screw threaded member engaging internal threads in said knee bolt whereby said second side strap is wedged in place and means for securing both of said side straps to the shank member.

14. An artificial limb comprising a shank member, a thigh member, a hollow aluminum knee member secured to the lower portion of the thigh member, a knee bolt extending through said knee member, a fiber bushing surrounding said knee bolt, cylindrical bearings mounted in recesses in said bushing where the latter passes through the walls of said knee member, side straps connecting the ends of said knee bolt with the shank member, and enlargements on said side straps extending around said knee bolt, said enlargements resting upon the top of the shank member and also engaging the outer walls of said knee member to retain said bushing and said cylindrical bearings in place and to prevent entrance of foreign substances.

15. An artificial limb comprising a shank

member, a thigh member, a hollow knee member secured to the lower portion of the thigh member, a knee bolt extending through said knee member, a fiber bushing surrounding said knee bolt, means for connecting the ends of said knee bolt to the shank member, and a check member secured at one end to the upper rear portion of the shank member and having its other end extending around said fiber bushing to constitute a bearing therefor.

16. An artificial limb comprising a shank member, a thigh member, a hollow knee member fitted to the lower portion of the thigh member and adapted to be turned toward either the right or left for lateral adjusting purposes, a shoulder on one of said members with which the other of said members is adapted to engage and limit relative longitudinal movement of the two members toward each other, means for securing said members together in adjusted position, and a pivotal connection between said knee member and said shank member.

17. An artificial limb comprising a shank member and a foot member pivoted together to form an ankle joint, a block in the lower end of said shank member, a coiled spring between the rear portions of said block and said foot member, a rod extending through said foot member, through said coiled spring and through said block, and a plate on the bottom of said foot member, said rod having screw threaded engagement with said plate whereby the position of said foot member may be adjusted about its pivot by turning said rod.

18. An artificial limb comprising a shank member and a foot member pivoted together to form an ankle joint, a block in the lower end of said shank member, a coiled spring between the rear portions of said block and said foot member, a rod extending through said foot member, through said coiled spring and through said block, a plate on the bottom of said foot member, said rod having screw threaded engagement with said plate whereby the position of said foot member may be adjusted about its pivot by turning said rod, a nut upon the upper end of said rod, and a resilient member interposed between said block and said nut whereby upon turning said nut the position of said foot member may be adjusted about its pivot independent of said first mentioned adjustment.

19. An artificial limb comprising a shank member and a foot member pivoted together to form an ankle joint, a sleeve fitted to the lower portion of the shank member and adapted to be turned toward either the right or the left for lateral adjusting purposes and then secured to said shank member, a shoulder on said sleeve with which said shank member is adapted to engage and limit rela-

tive longitudinal movement of the two members toward each other, and means carried by said sleeve for pivotally attaching said foot member.

5 20. An artificial limb comprising a shank member and a foot member pivoted together to form an ankle joint, a sleeve fitted to the lower portion of the shank member and adapted to be turned toward either the right
10 or the left for lateral adjusting purposes and then secured to said shank member, a shoulder on said sleeve with which said shank member is adapted to engage and limit relative longitudinal movement of the two mem-
15 bers toward each other, and means carried by said sleeve for pivotally attaching said foot member, the lower end of said sleeve below said shoulder being cupped outwardly to form a stop for coöperation with a
20 shoulder on said foot member.

21. An artificial limb comprising a shank member and a foot member pivoted together to form an ankle joint, a sleeve fitted to the lower portion of the shank member and
25 adapted to be turned toward either the right or the left for lateral adjusting purposes and then secured to said shank member, a shoulder on said sleeve with which said shank member is adapted to engage and limit rela-
30 tive longitudinal movement of the two members toward each other, and means carried by said sleeve for pivotally attaching said foot member, the lower end of said sleeve below said shoulder being cupped out-
35 wardly to form front and rear stops for coöperation with shoulders on said foot members in front of and at the rear of the pivotal connection.

22. An artificial limb comprising a shank
40 member and a thigh member pivoted together to form a knee joint, the upper portion of said thigh member being hollow and of hard fiber whereby a socket for the stump of the wearer is formed, said hard fiber
45 socket having a vertically extending opening, reinforcing strips for the edges of said opening having a breaking characteristic which is different from that of the body portion of said socket, and means for drawing
50 said edges together to cause the socket to fit the stump.

23. An artificial limb comprising a shank member and a thigh member pivoted together to form a knee joint, a flexor member
55 attached to said shank member for flexing said shank member into bent position at the beginning of a step, and an extensor member attached to said shank member for bringing said shank member into straight position at
60 the end of a step.

24. An artificial limb comprising a shank member and a thigh member pivoted together to form a knee joint, a flexor member for flexing said shank member into bent po-
65 sition, said flexor member extending between

the rear portion of said shank member and the lower portion of said thigh member, and guiding means within the front portion of said shank member over which the intermediate portion of said flexor member passes. 70

25. An artificial limb comprising a shank member and a thigh member pivoted together to form a knee joint, a flexor member for flexing said shank member into its bent position, said flexor member extending be-
75 tween the rear portion of said shank member and the lower portion of said thigh member, guiding means within the front portion of said shank member over which the intermediate portion of said flexor member passes, and an extensor member for bringing said shank member into straight position, said ex-
80 tensor member extending from the front portion of said shank member to the front portion of said thigh member. 85

26. An artificial limb comprising a shank member and a thigh member pivoted together to form a knee joint, a flexor member for flexing said shank member into bent po-
90 sition, an extensor member for bringing said shank member into straight position, and an attachment for connecting the upper end of said extensor member to the suspenders which hold said thigh member to the body
95 of the wearer, whereby when the suspenders are relaxed in a sitting position of the wearer, the flexor member is permitted to operate to bring the shank member into bent position.

27. An artificial limb comprising a shank
100 member and a thigh member pivoted together to form a knee joint, an extensor member for bringing said shank member into straight position, said extensor member being attached at one end to the lower por-
105 tion of said thigh member, guiding means within and attached to the rear portion of said shank member over which said extensor member passes, guiding means within and attached to the front portion of said shank
110 member over which said extensor member passes to the outside of said shank member and extends upwardly, a stop attached to said shank member adjacent said last mentioned guiding means, a stop secured to said
115 extensor member adapted to coöperate with said first named stop when said shank member is coming into straight position, and means for attaching the upper end of said extensor member to the suspenders which
120 hold said thigh member to the body of the wearer.

28. An artificial limb comprising a shank member and a thigh member pivoted together to form a knee joint, and a flexor
125 member for flexing said shank member into bent position, said flexor member being attached to said shank member and extending to the lower portion of said thigh member.

29. An artificial limb comprising a shank 130

member and a thigh member pivoted together to form a knee-joint, a flexor member for flexing said shank member into bent position, said flexor member being attached to said shank member and extending to the lower portion of said thigh member, and an extensor member attached to said shank member for bringing said shank member into straight position.

30. An artificial limb comprising a hollow thigh member of hard fiber constituting a socket for the stump of the wearer, a reinforcing strip for the upper edge of said thigh member having a breaking characteristic which is different from that of said hard fiber thigh member, and padding material extending over said upper edge and reinforcing strip.

31. An artificial limb comprising a shank member, a thigh member, a hollow knee member provided with an indentation adapted to be expanded into engagement with the inner wall of said thigh member at its lower end, and a pivotal connection between said knee member and said shank member.

32. An artificial limb comprising a shank member, a thigh member, a hollow knee member, a ledge on the inner wall of said knee member, said knee member being provided with a cut adjacent the upper edge of said ledge whereby the material above the latter may be indented to permit insertion into the lower end of said thigh member, said indented material being adapted to be expanded into engagement with said thigh member, and a pivotal connection between said thigh member and said shank member.

33. An artificial limb comprising a shank member, a thigh member, a hollow knee

member, ledges on the inner and outer walls of said knee member, said outer ledge being adapted to contact with the lower end of said thigh member and said knee member being provided with a cut adjacent the upper edges of said ledges whereby the material above the latter may be indented to permit insertion into the lower end of said thigh member, said indented material being adapted to be expanded into engagement with said thigh member, and a pivotal connection between said knee member and said shank member.

34. An artificial limb comprising a shank member, a thigh member, a knee member secured to the lower portion of said thigh member, a pivotal connection between said knee member and shank member, a bar extending from the rear of said shank member to said pivotal connection, and an adjustable stop mounted on said bar, said stop being adapted to engage said knee member when said shank member swings forwardly.

35. An artificial limb comprising a shank member, a thigh member, a knee member secured to the lower portion of said thigh member, a pivotal connection between said knee member and shank member, a bar secured to the rear of said shank member and having its upper end encircling said pivotal connection, a bolt screw-threaded through said bar, a plate swiveled upon the inner end of said bolt, and flanges extending from said plate into slidable engagement with the sides of said bar, said plate being adapted to engage said knee member when said shank member swings forwardly.

In testimony whereof I hereunto affix my signature.

OSCAR E. WORMAN.