No. 640,540. Patented Jan. 2, 1900.

R. E. DANIELS.

ARTIFICIAL LIMB.

(Application filed July 30, 1898.)

(No Model.) 8 Sheets—Sheet 1.

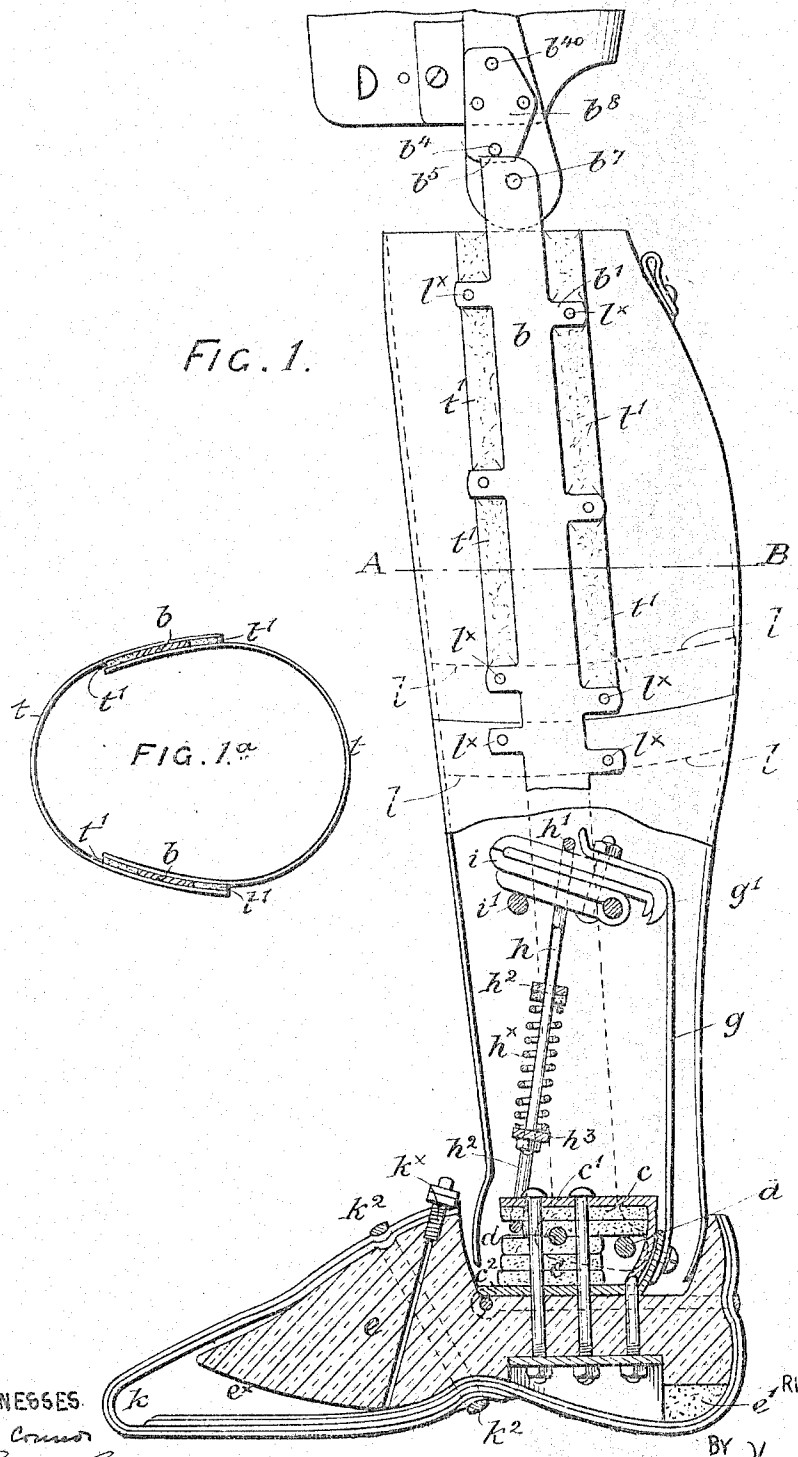


FIG. 1.

FIG. 1.a

WITNESSES.

S. E. Connor

Einar Chrystie

INVENTOR

RICHARD EDWIN DANIELS

BY Howson & Howson

HIS ATTORNEYS.

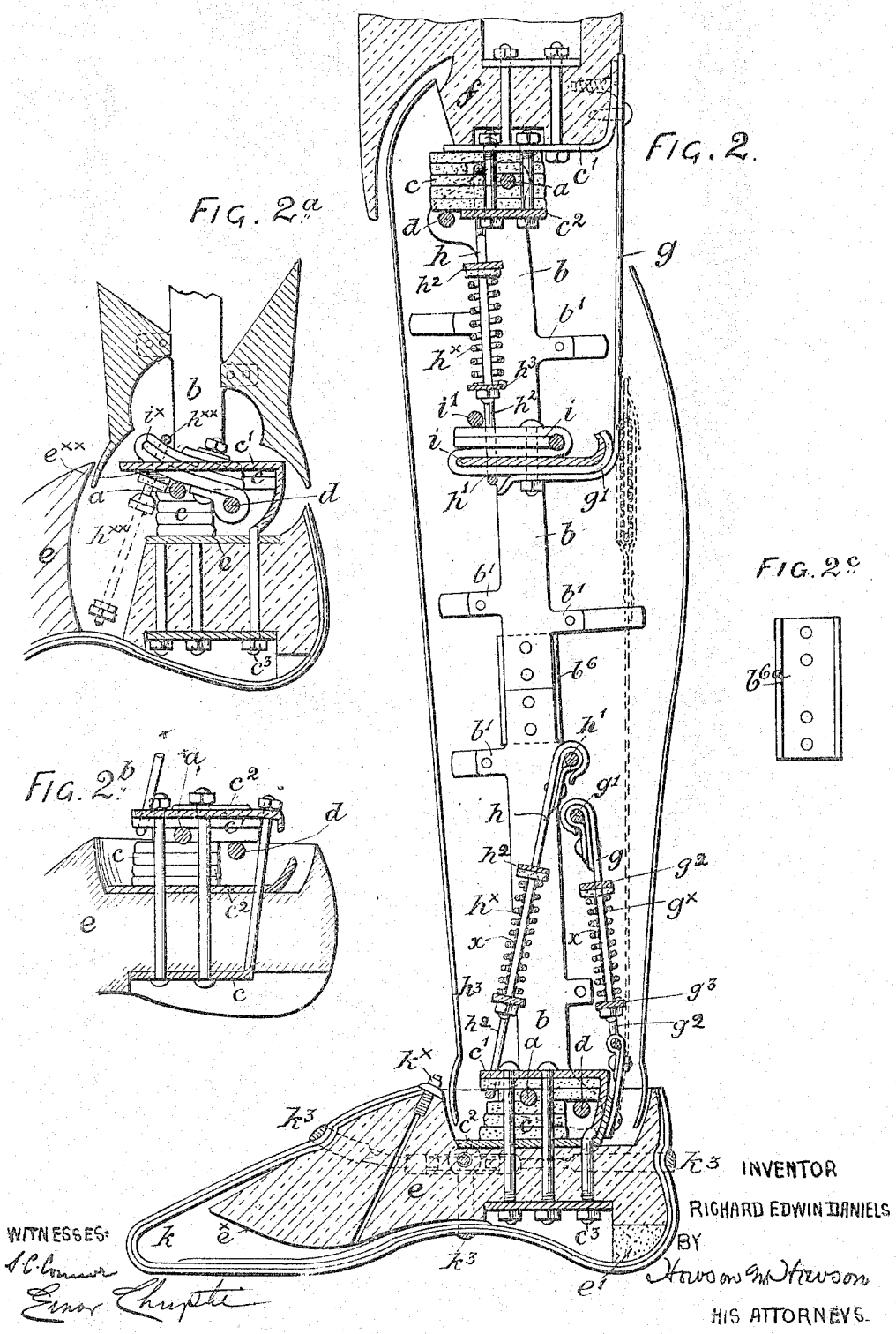
No. 640,540. Patented Jan. 2, 1900.

R. E. DANIELS.

ARTIFICIAL LIMB.

(Application filed July 30, 1898.)

(No Model.) 8 Sheets—Sheet 2.



WITNESSES:
S. C. Connor
Einar Chrystie

INVENTOR
RICHARD EDWIN DANIELS
BY
Howson & Hewson
HIS ATTORNEYS.

No. 640,540. Patented Jan. 2, 1900.

R. E. DANIELS.

ARTIFICIAL LIMB.

(Application filed July 30, 1898.)

(No Model.) 8 Sheets—Sheet 3.

FIG. 3.

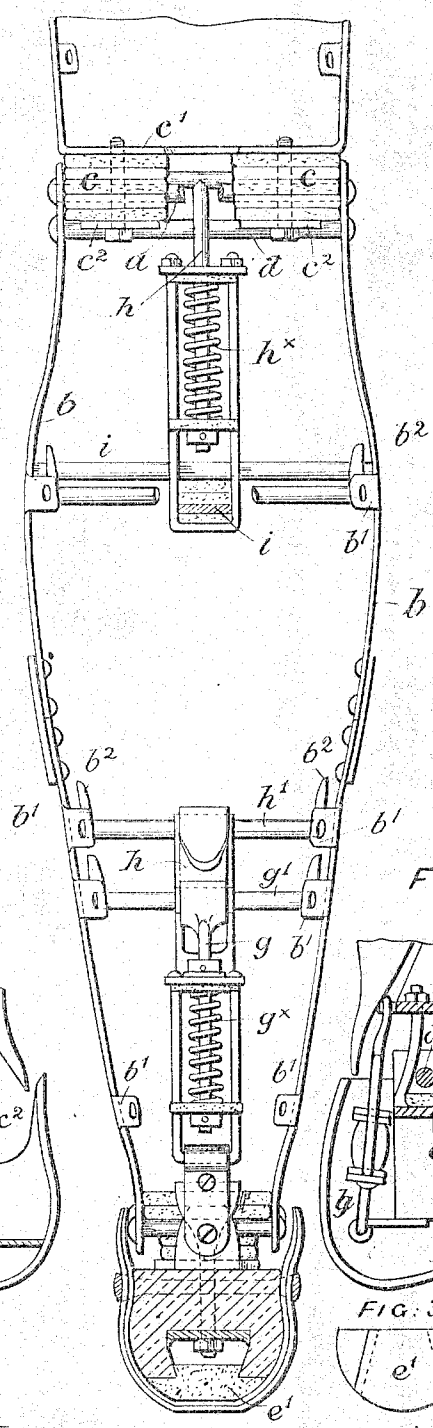


FIG. 3a.

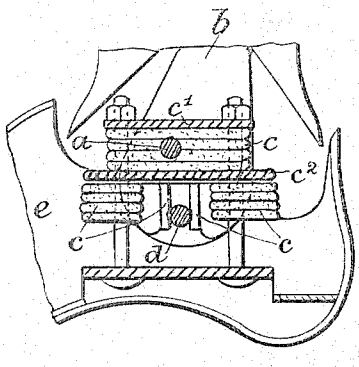


FIG. 3b.

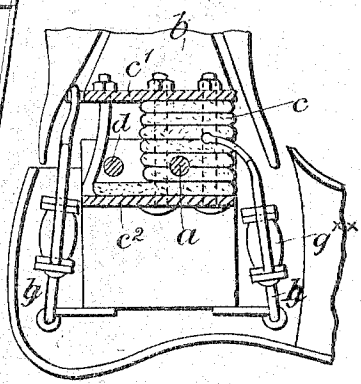


FIG. 3c.

WITNESSES:

L. C. Connor

Ennis Chrystie

INVENTOR

RICHARD EDWIN DANIELS

BY

Howson & Howson

HIS ATTORNEYS.

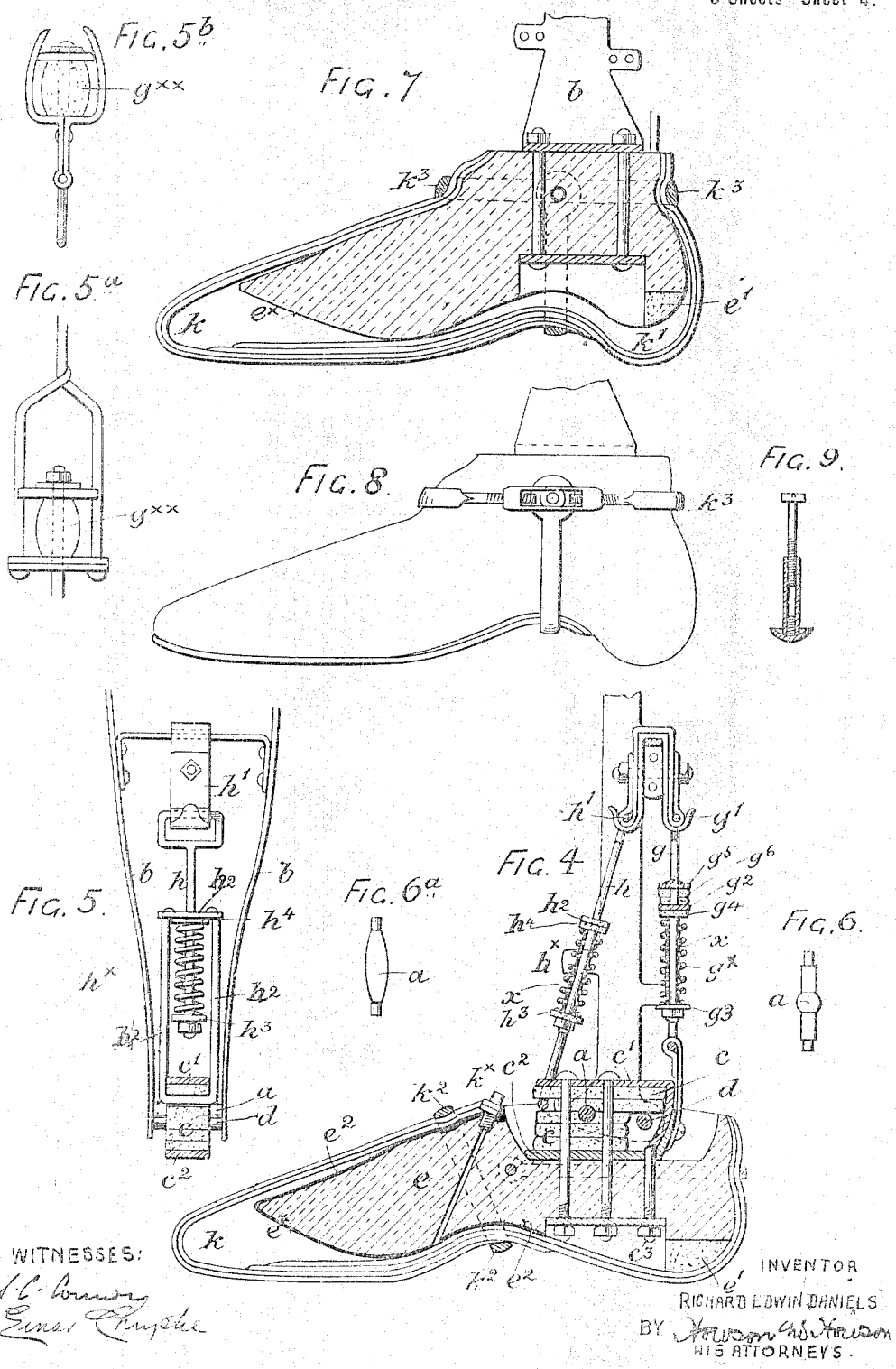
No. 640,540. Patented Jan. 2, 1900.

R. E. DANIELS.

ARTIFICIAL LIMB.

(Application filed July 30, 1898.)

(No Model.) 3 Sheets—Sheet 4.



WITNESSES:

S. C. Connor

Einar Chryske

INVENTOR

RICHARD EDWIN DANIELS

BY Howson and Howson

HIS ATTORNEYS.

No. 640,540. Patented Jan. 2, 1900.

R. E. DANIELS.

ARTIFICIAL LIMB.

(Application filed July 30, 1898.)

(No Model.) 8 Sheets—Sheet 5.

FIG. 10.

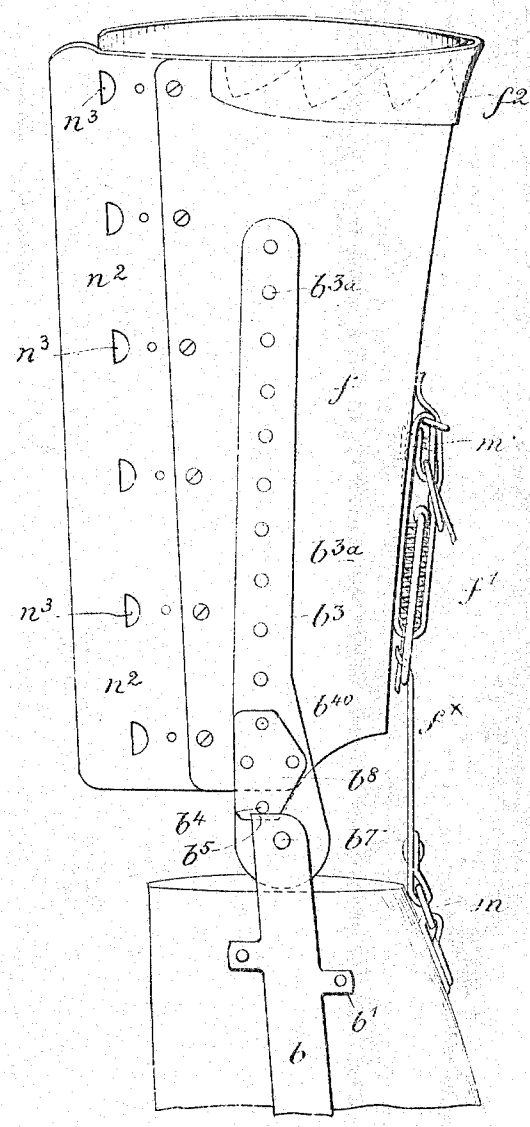
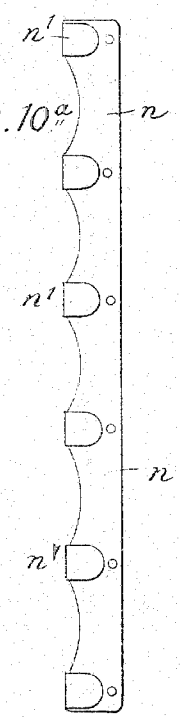


FIG. 10a



WITNESSES:

S. C. Connor

Einar Chrystie

INVENTOR

RICHARD EDWIN DANIELS

BY

Howson & Howson

HIS ATTORNEYS.

No. 640,540. Patented Jan. 2, 1900.

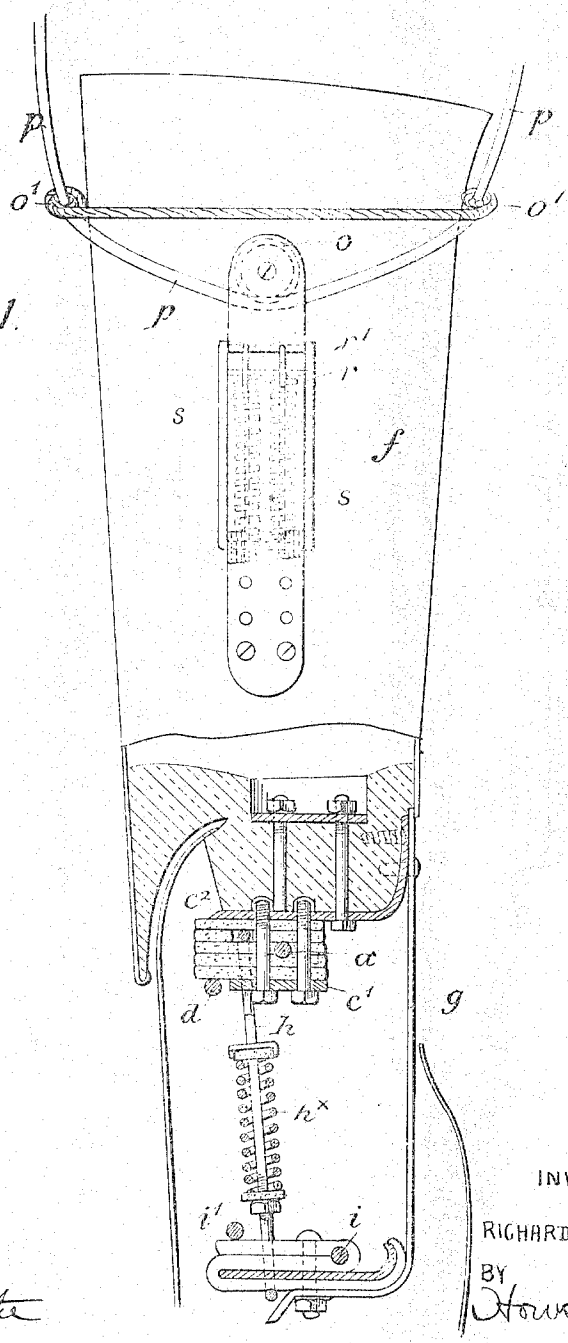
R. E. DANIELS.

ARTIFICIAL LIMB.

(Application filed July 30, 1898.)

(No Model.) 8 Sheets--Sheet 6.

FIG. 11.



WITNESSES:

INVENTOR

RICHARD EDWIN DANIELS

BY Howson & Howson

HIS ATTORNEYS.

No. 640,540.

Patented Jan. 2, 1900

R. E. DANIELS.

ARTIFICIAL LIMB.

(Application filed July 30, 1898.)

(No Model.)

8 Sheets—Sheet 7.

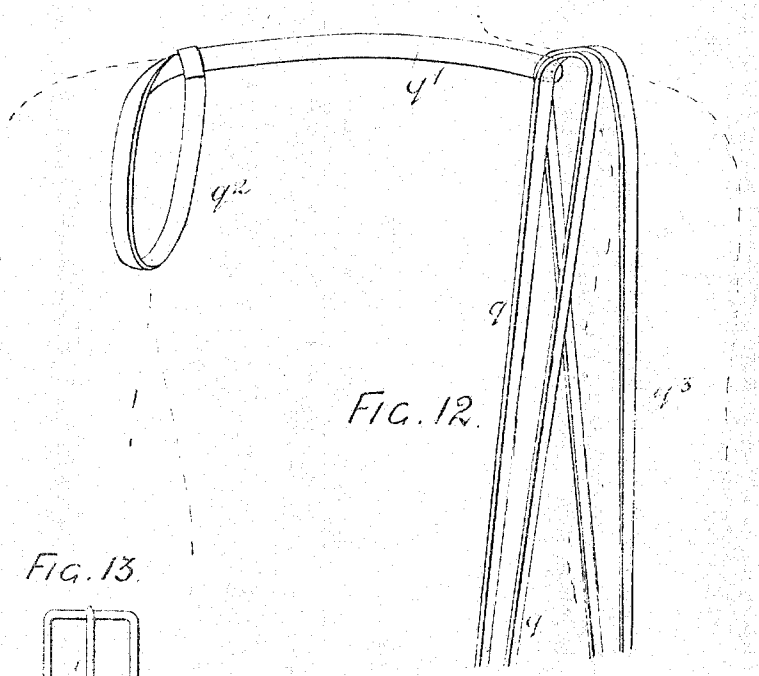


FIG. 12.

FIG. 13.

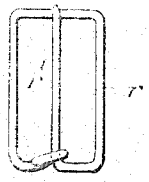
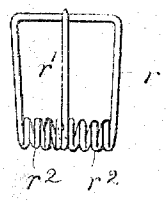
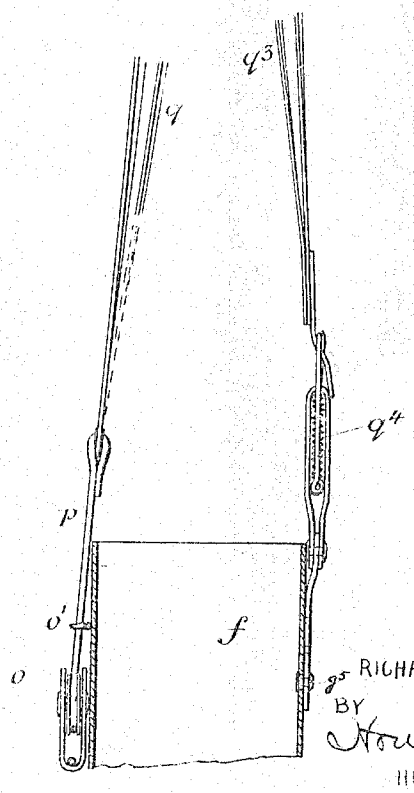


FIG. 14.





WITNESSES:

S. C. Connor

Emil Chapelle

INVENTOR

RICHARD EDWIN DANIELS

BY

Howson & Howson

HIS ATTORNEYS.

No. 640,540. Patented Jan. 2, 1900.

R. E. DANIELS.

ARTIFICIAL LIMB.

(Application filed July 30, 1898.)

(No Model.) 8 Sheets—Sheet 3.

FIG: 15.

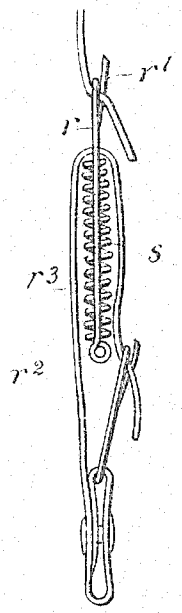


FIG: 16.

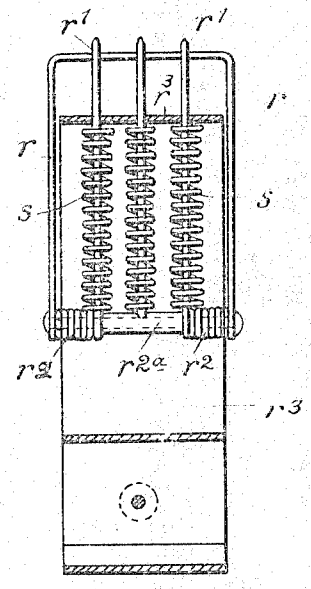
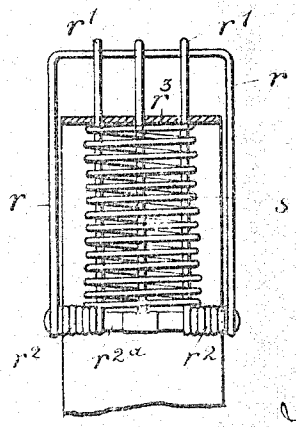


FIG: 17.



WITNESSES:

S. C. Connor

Ernest Chrystie

INVENTOR

RICHARD EDWIN DANIELS

BY Howson & Howson

HIS ATTORNEYS

UNITED STATES PATENT OFFICE.

RICHARD E. DANIELS, OF ROCHDALE, ENGLAND.

ARTIFICIAL LIMB.

SPECIFICATION forming part of Letters Patent No. 640,540, dated January 2, 1900.

Application filed July 30, 1898. Serial No. 687,273. (No model.)

To all whom it may concern:

Be it known that I, RICHARD EDWIN DANIELS, a subject of the Queen of Great Britain, residing at Rochdale, in the county of Lancaster, England, have invented new and useful Improvements in and Relating to Artificial Legs or Limbs, of which the following is a specification.

My invention relates to artificial limbs, the objects of my invention being to provide for every variety of circumstances attending amputations, whether above or below the knee, and to combine lightness of weight with facility of application to the wearer, ease in wear, and absence of noise in use.

My improvements will be readily understood on reference to the accompanying drawings.

Figure 1 is a side elevation, the lower part in section, of an artificial limb with my improvements attached thereto. Fig. 1^a shows a section through about the line A B on Fig. 1. Fig. 2 is a side elevation in section of another artificial limb with ankle-joint and knee-joint similar. Fig. 3 is a section taken at right angles to Fig. 2, the section running through the heel and the upper part, showing a construction suitable for an amputation nearer the knee-joint than that shown at Fig. 2. Fig. 2^a shows a detached part applicable to Fig. 2. Figs. 2^a, 2^b, 3^a, 3^b, 3^c, and 4 show modified forms or arrangements of ankle-joint. Fig. 5 shows a face view of one of the spring-straps hereinafter described. Figs. 5^a and 5^b show parts of a spring strap or link when a rubber buffer is used in place of a coiled spring. Figs. 6 and 6^a show modified forms of joint-pins for the ankle-joint. Fig. 7 is a section showing how my pneumatic toe and heel can be applied to a foot with stiff ankle-joint. Fig. 8 is an external elevation thereof, and Fig. 9 shows detached the bolt fixing the foot and the band for securing the pneumatic casing. Fig. 10 shows in elevation one form of the thigh piece or cover and knee-joint similar to that shown on Fig. 1, the cover being unfastened and the removable tongue or socket-strip displayed, the knee-joint being merely an auxiliary to a natural joint where the amputation is below the knee. Fig. 10^a shows an elevation of the catch-plate with hooks corresponding to the eyes in the socket-strip or tongue. Fig. 11 shows an inner side elevation of a thigh-cover with the form of knee-joint suitable for amputation above the said joint, the latter being shown in section, and this figure illustrates how the inner side of the thigh-piece is supported by the band or strap shown detached at Fig. 12. Figs. 13 and 14 are detached views of the buckles which I propose to use, as hereinafter described. Figs. 15, 16, and 17 show their application to straps or bands.

The first part of my invention relates to a joint which is applicable to both ankle and knee. It consists of a stud or pin *a*, Figs. 1, 2, 2^a, 2^b, 3, and 4, secured to the side irons *b* of the limb, supported in a bearing of leather or other similar yielding material *c*, and a second pin *d*, also secured to the side irons *b*, forming a stop to limit the action of the joint, as shown. The yielding material *c* is secured between two metal plates *c'* c^2, bolted or clamped together and suitably supported either by the foot *e* or the thigh-piece *f*, one of the plates, *c'*, being generally in the form of a cap bent around the end of the bearing and formed with a screw c^3 at the end. Fig. 3^a, however, shows the yielding material so disposed between and beneath the plates *c'* c^2 that the lower parts of the said material are stopped by the stop-pin *d*. The rear of this bearing is connected by a strap *g* or, if desired, a link *g* and metal or rubber spring $g^\times$ to a point *g'* about one-third of the way up or down the shank part of the leg, and the front of the bearing is connected by a link or strap *h*, looped around the plate *c'*, and a spring $h^\times$ to a second point *h'* at about the same level. The central spindle, around which the springs $g^\times$ $h^\times$ work, is preferably provided with a leather or other suitable protection, as seen at *x*, Fig. 4, to prevent the metal spring from clicking or wearing against the spindle. If a strap *g* is used without a spring, which is preferable in the case of a knee-joint, (see Figs. 1 and 11,) these two links *g* and *h* are connected to a lever *i*, pivoted to the side irons *b* of the shank of the limb and resting against the stop *i'*. A great advantage in this arrangement is that the front spring $h^\times$ will in the case of a knee-joint be so arranged with regard to the pivot or joint *a* as to have

three actions: It will hold the shank normally straight with the thigh, it will allow the bending of the knee-joint when the wearer is sitting down, for example, and will effect the further motion of the shank, say to draw the foot beneath a seat without manual assistance.

I may in some cases connect the thigh to the rear or heel part of the foot (say the cap c') by a spring and strap, as dotted at Fig. 2, and dispense with the back strap g of the knee-joint.

The springs $g^{\times}$ $h^{\times}$ work within the metal loop or strap g^2 h^2, respectively, and an adjustable sliding bridge-piece g^3 h^3, preferably made of leather, regulates the strength or resistance of the spring $g^{\times}$ or $h^{\times}$. A similar leather piece g^4 h^4, Fig. 4, lines the end of the metal loop, and in the case of the rear spring g^3 a collar g^5 and leather or other buffer g^6 are fixed on the central spindle to limit the action of the spring, or a rubber buffer may be used instead of a metal spring, as seen at $g^{\times\times}$, Fig. 5^a.

The studs or pins a and d, forming the pivot and stop of the ankle-joint, may be somewhat barrel-shaped or made with globular enlargement at the center, as shown detached at Figs. 6 and 6^a, to allow lateral and diagonal flexion, as well as the ordinary forward flexion, of the ankle-joint in case the foot e is pressed down on a small stone or uneven surface. In some cases the ankle-joint pin a and stop-pin d may be fixed to the foot e, as seen at Fig. 3^b, the springs $g^{\times}$ $h^{\times}$ being reversed and passing into a cavity in the foot e and the bearing c c' c^2 being fixed to the side irons of the shank. This Fig. 3^b shows the side iron and the plate c' combined in one piece, and in some cases where there is no room for the springs $g^{\times}$ $h^{\times}$ and their adjuncts above the foot (in the case of very low amputation) I use one central spring-link $h^{\times\times}$, Fig. 2^a, in a cavity in the front of the foot and a lever $i^{\times}$, pivoted to the stop-pin d. This lever rests on the joint-pin a and works around it when the ankle-joint is bent until the end of the lever is stopped by a projection $e^{\times}$ on the plate c' or foot e, and further motion is checked by the spring $h^{\times\times}$, which bears against the under side of the projection $e^{\times\times}$, and this checks the joint just before the stop-pin d comes into contact with the bearing c. In all cases these springs $g^{\times}$ $h^{\times}$ $h^{\times\times}$ act as compressor-springs and are already compressed to resist the extension of check straps or links which hold the joint in place, and this takes a great strain off the joint-pins and bearing-plates.

The front part of the foot e, whether in the form of a wooden block or shell-piece of aluminium or otherwise formed, is shorter than usual and inclined upward at $e^{\times}$ from the ball of the foot toward the front or point, and this part of the foot is inclosed in an inflated air-cushion k, forming the toe of the foot e.

The foot e is preferably covered with a rubber cap e^2, which protects the same and also insures an air-tight joint with the pneumatic cushion k, Fig. 4. Such air-cushion may extend at k' beneath the heel also (see Fig. 7) and is in any case preferably connected to the foot by a cord k^2 or the link k^3 around the instep or ankle and beneath the arch of the foot—say as seen at Fig. 2 or at Figs. 1 or 7—the foot being preferably grooved for the cord to make a firmer binding of the pneumatic casing k or k k' thereon. Thus when the pneumatic case is at both toe and heel I have a pneumatic foot k with a wooden or other core e therein, and there will be no sharp angle bearing upon the cushion and likely to wear the same.

$k^{\times}$ is the inflating-tube for the cushion.

The heel of the foot e is mortised or grooved, as seen at Fig. 3, and a block of rubber e' (see also Figs. 1, 2, 3, 3^c, 4, and 7) is let into the groove or mortise to form an elastic cushion for the heel, the groove in which is tapered inward to fit the taper of the dovetailed part of the block e'. (Shown at Fig. 3^c.) The upper part of the foot is hollowed out for the bearing and to allow free play of the foot e, the bottom of the shank fitting into the foot. (See Figs. 1, 2, and 3.) The shank is formed of the side irons b, before named, and at certain parts is made with side projections b' or extensions in width, to which bands or half-bands of metal l, Fig. 1, may be riveted at $l^{\times}$ to complete a frame upon which canvas or other suitable material may be stretched or built to form the leg. These projecting parts b' may also be made with upwardly-extending points or fingers b^2, upon which the casing may be suspended by suitable sockets or pockets, or wooden shell-pieces may be used or other parts or sections forming the shape of a natural limb. The extensions b' allow of the riveting of parts to the side irons b without weakening the latter, which have really to support the weight put on the leg or foot, and the points b^2 allow for readily removing the casing to get at the inclosed working parts for adjustment or repair. The side irons b are jointed to extensions or further side irons b^3 on the thigh-cover f or thigh-piece, and the irons b^3 are provided with a stop b^4, the upper end of the shank side irons b being provided with a cam-shaped piece b^5 to prevent the knee-joint thus formed from bending inward—that is, backward—on its pivot b^7. (See Figs. 1 and 10.) I prefer to fix the stop b^4 in a reversible plate b^8, provided with a second stop-pin b^{40}, as shown. Further, the back of the shank at m and of the thigh-piece at m' may be connected by a check-strap $f^{\times}$ and spring f'. (See Fig. 10.) This will deaden or prevent the noise at the knee-joint when walking. The thigh side irons b^3 are fitted to the thigh-cover f, Fig. 10, which is open from top to bottom, as usual, but provided along one edge with a plate n, having hooks n', (seen detached at Fig. 10^a,) and along the other edge with a removable flap or tongue n^2, having holes n^3, into which the hooks en-

gage. This dispenses with the usual lacing, which is a tedious operation. The inner upper edge of the thigh-cover *f* is provided with a pulley *o* and guides *o'*, Fig. 11, under which a suspending-cord *p* is passed, and this cord *p* is attached to straps or bands or webbing *q*, connected to a yoke, preferably of webbing *q'*, provided with a loop q^2, through which is passed the arm and shoulder at the side of the body opposite to the artificial limb, one of the straps *q* passing over the second shoulder. (See Fig. 12.) The two straps q^3, connected to the same yoke *q'*, are passed also at front and back of the second shoulder and connected together at their lower end, where they are attached to a spring-buckle q^4, pivoted at q^5 to the outer side of the thigh-cover *f*. This forms a very easy-fitting efficient support for the artificial limb, which is thus hung directly from the shoulder immediately above it, and the raising of the limb by this shoulder is quite natural when walking. In the case of amputation of both legs q^2 might be dispensed with.

The side irons *b* and b^3 may be made hollow or tubular, and those of the shank may be made in parts, so as to be adjustable in length, if desired. This is effected, as seen at Fig. 2, the two parts being connected together by a plate b^6, which can be replaced by a longer plate b^{6a}, (seen detached at Fig. 2^a,) if desired. The side irons b^3 are made with a series of rivet-holes b^{3a}, so that they can be let down upon the cover *f*, as seen at Fig. 10, to lengthen the thigh, if desired. Those of the shank are so arranged also as to carry more weight at the back of the knee-joint pin than at the front, and thus they will swing forward automatically at every step in walking.

I propose to fasten a strip or strips of leather f^2 around the top of the rear part of the thigh-cover *f* to strengthen the same.

The buckle *r*, which I have invented for the suspension of the limb, (or for other parts requiring such a buckle,) is made with the prong or prongs *r'* in one part with the frame (see Figs. 13 and 14) and, if desired, in one with a spring r^2, holding it or them to the frame *r*.

For a spring-buckle, as seen at Figs. 12, 15, and 16, I fit a spring *s* around each prong *r'* or around all the prongs *r'*, Fig. 17, bearing against the cross-bar r^{2a} and against a looped strap r^3, through which the prongs pass and which is connected to one of the ends or parts to be joined by the buckle, the frame *r* being fastened, as usual, by the prongs *r'* to the other end or part, so that the weight of the limb is suspended on the springs *s*.

I sew the cover *l* of the limb to both sides of the side irons, as seen at Fig. 1^a, and I protect the stitching by strips of leather *l'*, placed between the projections *b'*. This prevents the irons from working up and down and allows the cover to be in some cases entirely supported by the stitching.

I claim as my invention—

1. A joint for ankle or knee consisting of a pivot-pin and a stop-pin secured to one part and a bearing-block of soft material secured by suitable plates and bolts to the other part, substantially as described.

2. A joint for ankle or knee consisting of a pivot-pin stop-pin, bearing-block of soft material, and securing-plate a spring connection being made between the front of the bearing-block and a point on the shank and a check-strap between the two parts jointed together substantially as hereinbefore described.

3. A joint for ankle or knee consisting of a pivot-pin, stop-pin and bearing-block of soft material, and securing-plate, a spring connection being made between the front of the bearing-block and a point on the shank and a spring check-strap between the two parts jointed together substantially as hereinbefore described.

4. In an ankle-joint of the above description an ankle-joint pin made larger at the central part to allow lateral and diagonal flexions of the ankle-joint, substantially as hereinbefore described.

5. A knee-joint with cam-piece on the shank side iron and reversible stop-plate on the thigh side iron, substantially as hereinbefore described.

6. A knee-joint with front spring connection and back check-strap connection, as and for the purposes set forth.

7. The side irons of an artificial leg made with side enlargements and bands secured to said enlargements to which a casing is attached, as and for the purposes described.

8. Side irons for an artificial leg made with side enlargements having vertical pegs, and a casing adapted to be hung thereon, substantially as described.

9. A pneumatic foot having a wooden core part extending from the heel forwardly toward the toe, covered with a flexible material vulcanized thereto around the ankle or instep, said covering extending beyond the front of the core and forming an air-chamber at the toe, as and for the purposes set forth.

10. An artificial limb provided with means for suspending it, consisting of straps adapted to pass over one shoulder and secured to the limb, and a yoke secured to said straps and adapted to pass over the other shoulder, substantially as described.

11. An artificial limb, provided with means for suspending it, consisting of straps adapted to pass over the shoulder, a pulley and a spring secured to the limb and to the straps, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

RICHARD E. DANIELS.

Witnesses:
CHARLES A. DAVIES,
JNO. HUGHES.