E. Cotty,

Artificial Knee-Joint,

No. 37,087. Patented Dec. 9, 1862.

Fig: 3.

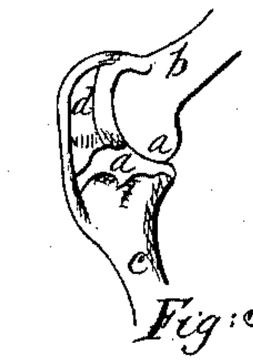


Fig: 2.

Fig: 1.

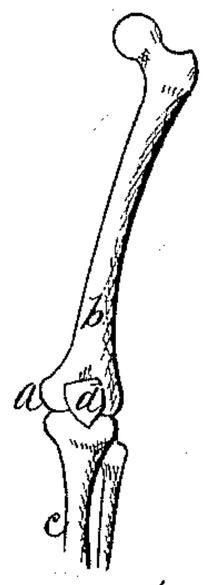


Fig: 4.

Fig: 12.

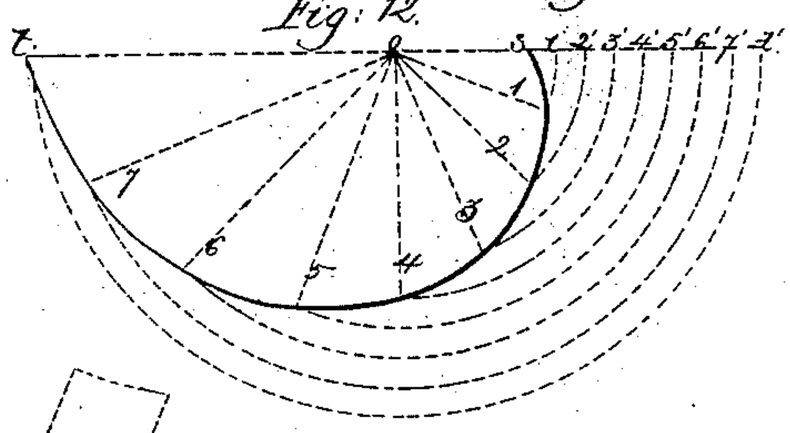


Fig: 5.

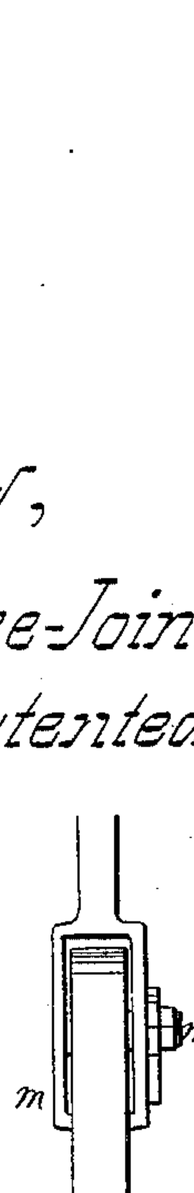


Fig: 6.

Fig: 10.

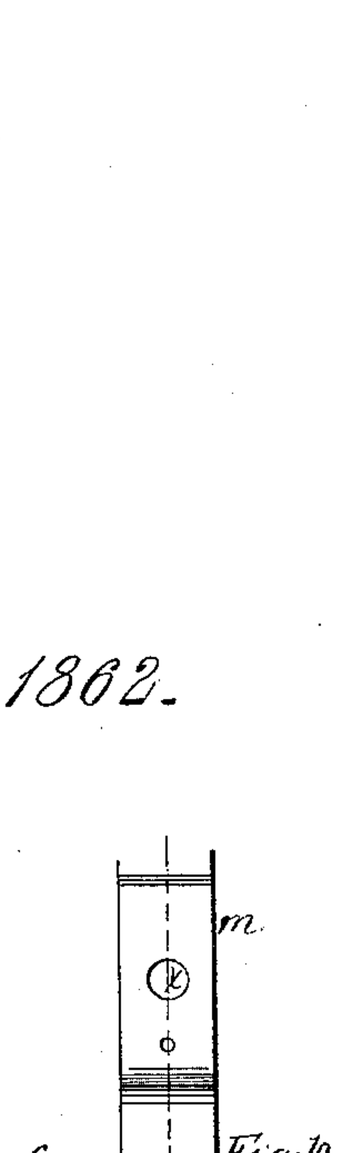


Fig: 11.

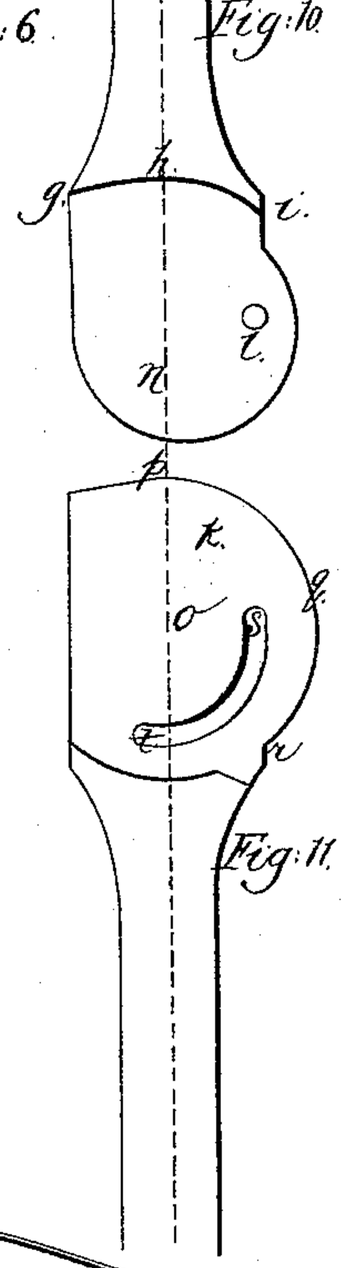


Fig: 7.

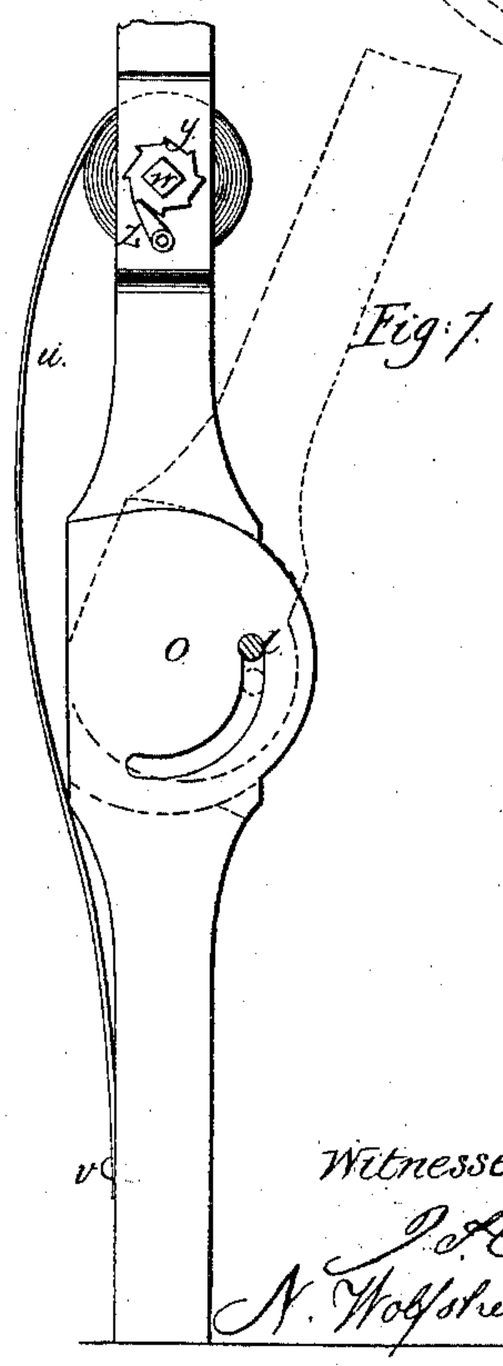


Fig: 8.

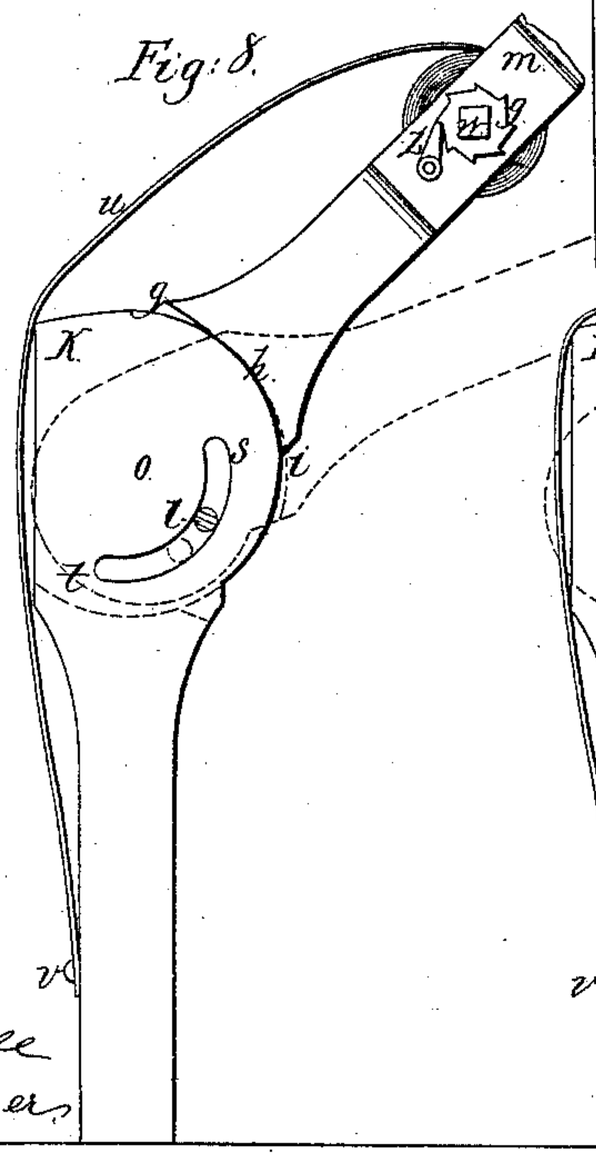
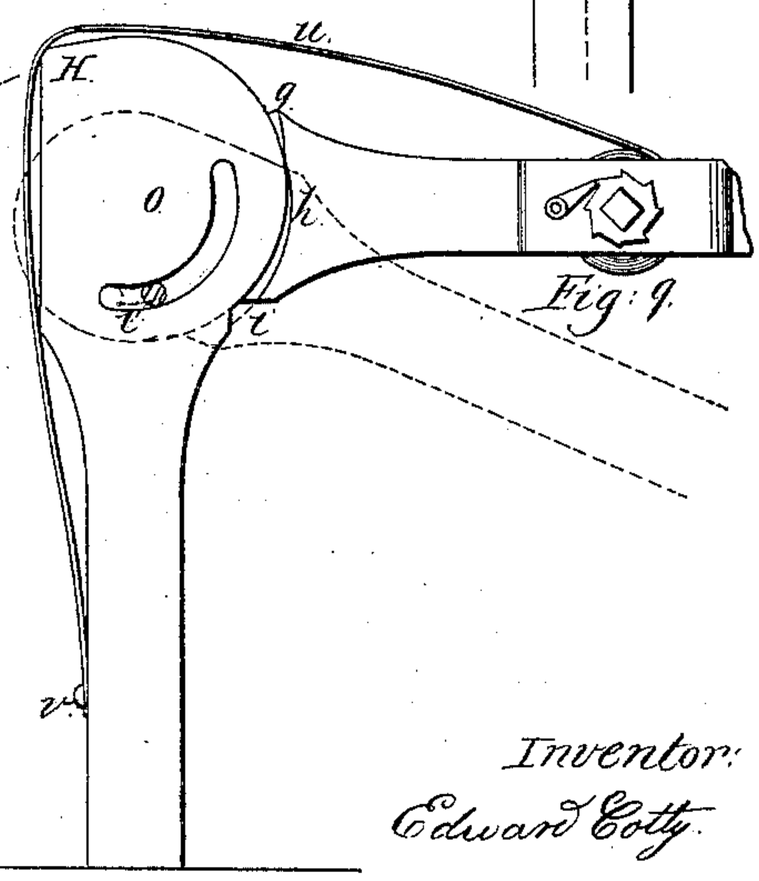


Fig: 9.



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UNITED STATES PATENT OFFICE.

EDWARD COTTY, OF WASHINGTON, DISTRICT OF COLUMBIA.

IMPROVEMENT IN ARTIFICIAL KNEE-JOINTS.

Specification forming part of Letters Patent No. **37,087**, dated December 9, 1862.

To all whom it may concern:

Be it known that I, EDWARD COTTY, of Washington, in the District of Columbia, have invented a new and useful Improvement in Knee-Joints for Artificial Legs; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The nature of my invention consists in the peculiar construction of the joint connecting the two parts of the skeleton of an artificial leg, which represent the lower part of the thigh-bone (or femoris) and the shin-bone (tibia) below, in connection with a spring representing the expanded fibers of the extensor tendons, by which construction and arrangement the natural movement of the knee-joint (femoro-tibæ) is imitated most successfully.

In the annexed drawings, making a part of this specification, the Figures 1, 2, 3, and 4 explain the construction of the human knee-joint, viz: Fig. 1 representing a front view. Fig. 2 is a side view of the knee-joint without muscles. Figs. 3 and 4 represent the side and front view, respectively, of the knee-joint with the extensor tendons. Fig. 5 shows my improved joint in front, and Fig. 6 shows the same in rear. Figs. 7, 8, and 9 are side views of my joint in different positions of the upper part, representing the femur or thigh bone. Fig. 10 shows the upper part of my joint detached, and Fig. 11 represents the lower part of my joint separately. Fig. 12 is a diagram showing the construction of an Archimedean spiral, the curve which I use in constructing the slides in the lower part of my improved joint.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction and operation.

The knee-joint is a ginglymus or hinge joint, formed by the condyles *a*, Figs. 1, 2, 3, and 4, of the femur *b* above, the head of the tibia *c* below, and the patella (rotula, knee-pan) *d* in front. The patella is situated at the anterior part of the knee-joint, being attached by a ligament (ligamentum patellæ) to the tibia *e*, so that its position with regard to the joint varies according to the movements of that bone. Its anterior surface is covered by the expanded fibers of the extensor tendons *f*. The movement itself follows the laws of an eccentric motion, shortening the contracted leg more than would be done by a concentric motion of the femur and tibia, and this fact, important as it is in aiding the movements of the leg, has hitherto been neglected or overlooked.

The object of my invention is to imitate this eccentric motion of the knee-joint in the simplest manner, avoiding all unnecessary friction, and making the shortening or reduction in the length of the leg proportional to the angle formed by the parts representing the femur and the tibia, respectively.

My hinge-joint consists of two principal parts, the upper part, representing the femur, being illustrated by Fig. 10, and the lower part, representing the tibia, is shown in Fig. 11. The first or upper part is provided with curved projecting shoulders on each side. (Shown by the lines *g h i* in Figs. 8, 9, and 10.) These rest on the two laps *k* of the lower part, Fig. 11, and serve as condyles of the femur. It is further provided with a pin, *l*, moving in slides cut out of the two laps *k* of the lower part, holding the shoulders *g h i* in contact with the curvature of those laps, and serving, therefore, as the interposed fibro-cartilages, which, in the human knee, connect the femur with the tibia. A certain distance above the shoulders *g h i* the first or upper part of my knee joint has a square opening, *m*, Figs. 5, 6, and 10, to receive a spring-coil, to which I refer afterward. The second or lower part of the joint is separately represented in Fig. 11. The head of this part is formed by two laps, *k*, which are intended to inclose the projection *n* of the first or upper part above described. These laps are shaped as shown in the drawings, the line *p q r* being part of a circle the center *o* of which is placed in the center line of the lower part, and they are perforated in the shape of a curve, *s t*, thus serving as slides for the pins *l* of the upper part. The point *t* of these slides is farther apart from the center *o* than the point *s*, and the angle *t o s* should be at least one hundred and twelve degrees. From this it will be understood that both parts, being connected by placing the projection *n* of the upper part between the two laps *k* of the lower part and the pin *l* into the slides *s t*, an eccentric movement will take place by turning the upper part toward the lower around the

pin *l*, provided, however, the shoulders *g h i* remain in contact with the curved part *p q r* of the laps. To attain this object, the two parts representing the femur and the tibia are further connected by a spiral spring, *u*, fastened to the front of the lower part at *v*, and to the upper part by an axle, *w*, passing through holes *x* in the aperture *m*. The axle *w* itself is provided with a ratched wheel, *y*, held in position by a stop, *z*, by which means the spring-coil may be wound up to receive any necessary strain. By this strain the shoulders *g h i* of the upper part are always brought in contact with or pressed against the circular curvature *p q r* of the laps of the lower part, and the stretching out of the artificial leg, respectively, the opening or extension of the knee-joint is greatly facilitated. It will be seen that this spring not only resembles but actually represents the fibers of the extensor tendons. (Shown in Figs. 3 and 4.)

After this description a few words will be sufficient to explain Figs. 7, 8, and 9.

In Fig. 7 the black lines show the position of the upper and lower parts and the spring when the joint is extended—that is, when the angle formed by the axes of the upper and lower parts amounts to one hundred and eighty degrees. The red lines in this figure show the upper part in a position varying twenty-two degrees from the former.

In Fig. 8 the black lines show the knee-joint when the angle of the axes of the upper and lower part amounts to one hundred and thirty-five degrees, and the red lines thereon represent the upper part in a position twenty-two degrees nearer toward the lower part.

In Fig. 9 the black lines represent the upper part forming an angle of ninety degrees with the lower part, and the red lines when this angle amounts only to sixty-eight degrees.

In these drawings the movement is limited to an angle of one hundred and twelve degrees; but it can be extended, if necessary.

A few remarks remain to be made about the curvature of the slides *s t*. Since the point *t* is more distant from the center *o* than the point *s*, it will be seen that the pin *l*, and with it the whole upper part, is withdrawn from this center *o*. To graduate this movement most minutely to the proportion of the angular space described by the upper part, I accept a curve called "Archimedean spiral," the construction of which is shown in Fig. 12.

Let *o* represent the center, *s* the nearer, and *t* the farther, point. Then divide the angle *s o t* into any number of equal parts—say in eight parts—marked 1, 2, 3, &c., and also the difference of the distances *s o* and *t o*—viz., the space *s t'*—into the same number of equal parts marked 1′ 2′ 3′, &c., and then cut the lines o' o^2 o^3, &c., by the circular arcs drawn from point *o* as center and the points 1′ 2′ 3′, &c. The intersections of the corresponding lines represent points of the curve wanted.

Any material shaped in the form of a human leg may be fastened easily around this knee-joint.

The advantages of my invention are as follows: First, a close imitation of the actual movement in the knee-joint of a sound human leg, therefore great comfort in use; secondly, great simplicity, and therefore cheapness; thirdly, a minimum of friction, and therefore of wear.

I do not claim the construction of an artificial leg; nor do I confine myself to the peculiar shape of slide *s t*, as this may be changed without abolishing the principle of my eccentric motion; but

What I claim as new and of my invention, and desire to secure by Letters Patent, is—

The eccentric hinge formed of two parts representing the lower part of the femur and the tibia, in connection with the adjustable spring *u* or any other substantially the same representing the fibers of the extensor tendons, as set forth and described.

EDWARD COTTY.

Witnesses:

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N. WOLFSHEIMER.