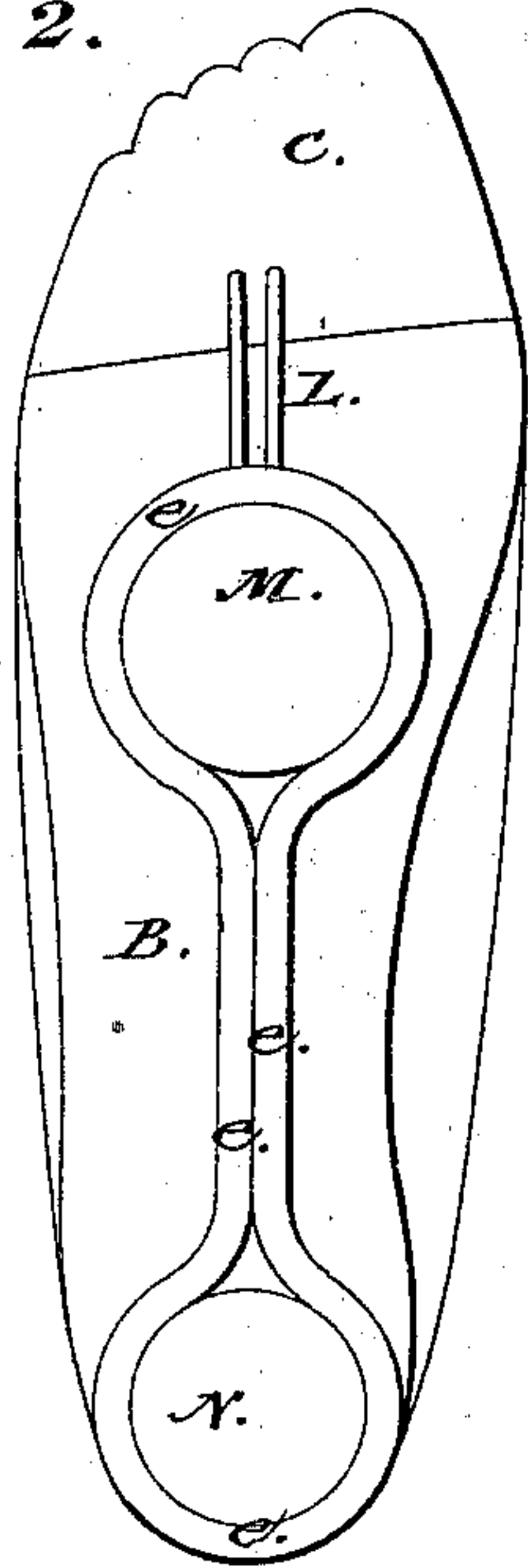


**B. F. PALMER.**  
**Artificial Legs.**

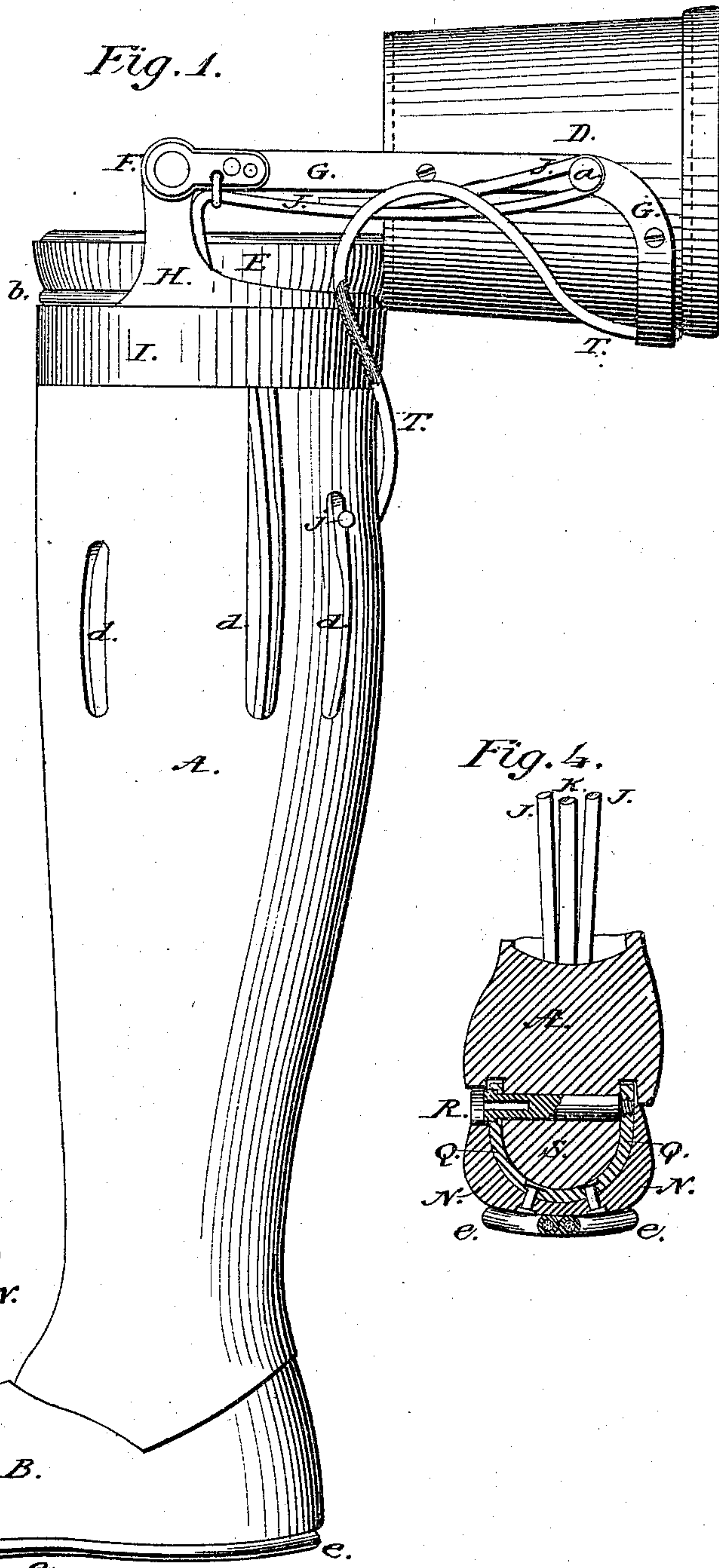
No. 137,711.

Patented April 8, 1873.

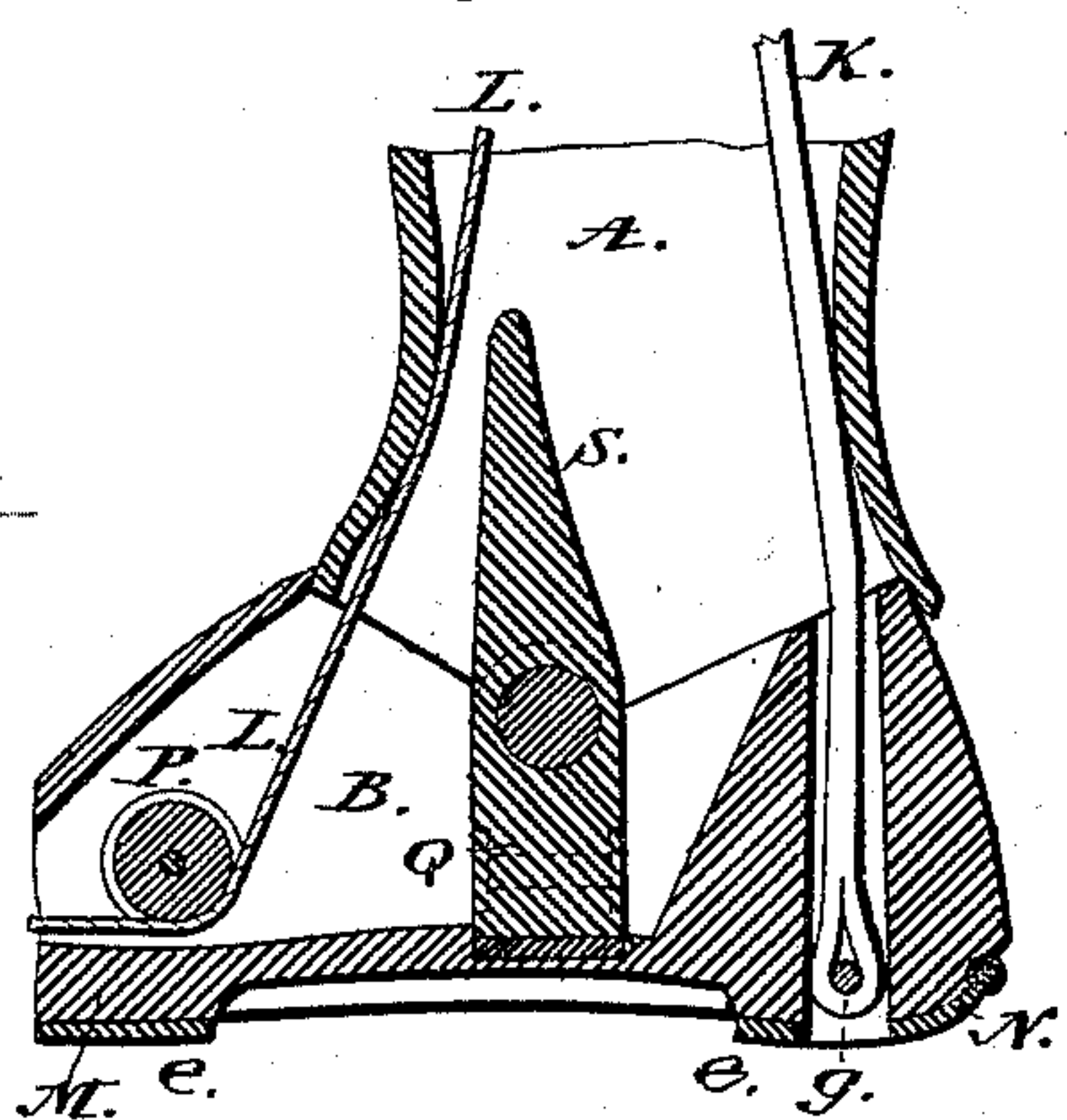
*Fig. 2.*



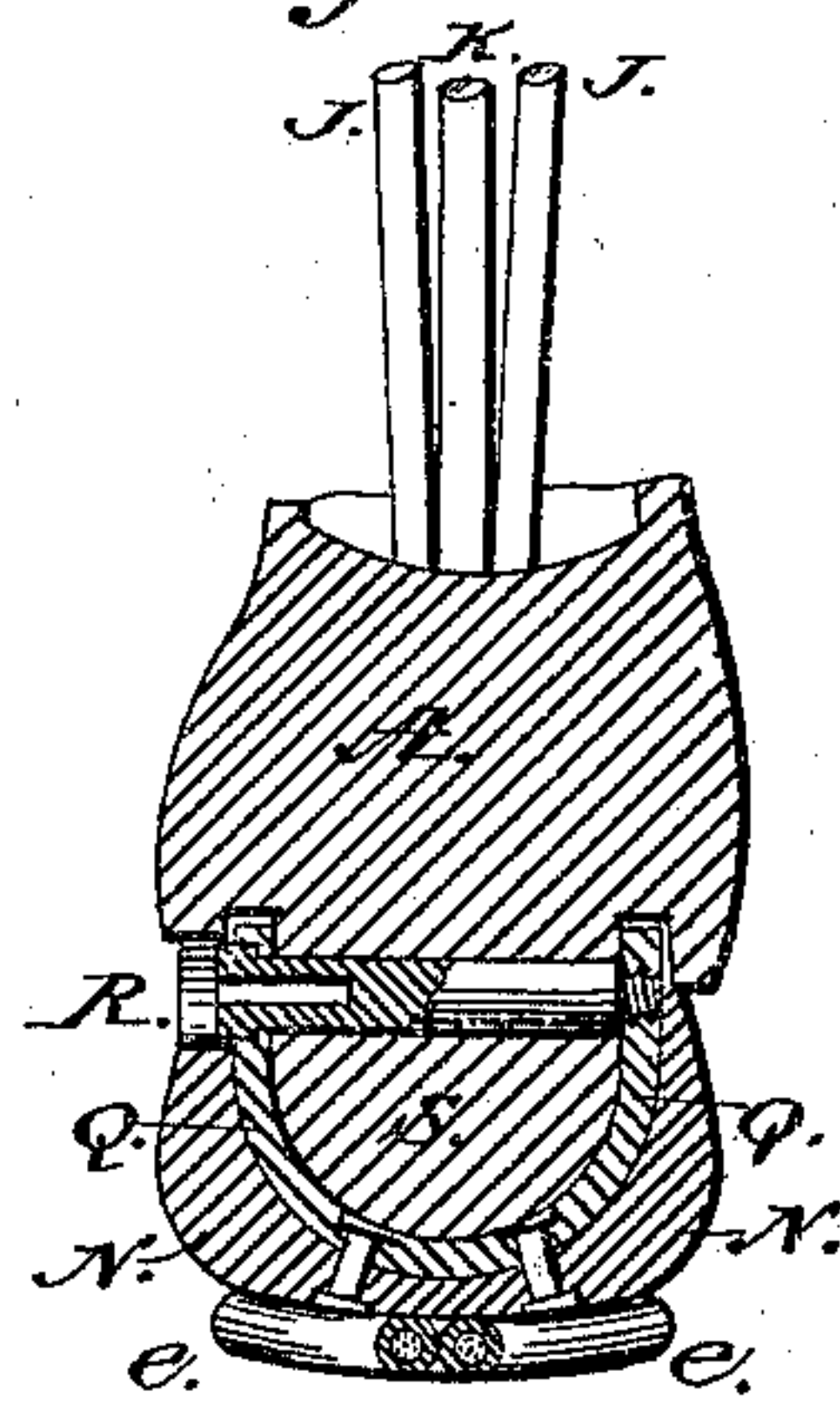
*Fig. 1.*



*Fig. 3.*



*Fig. 4.*



*Attest;*

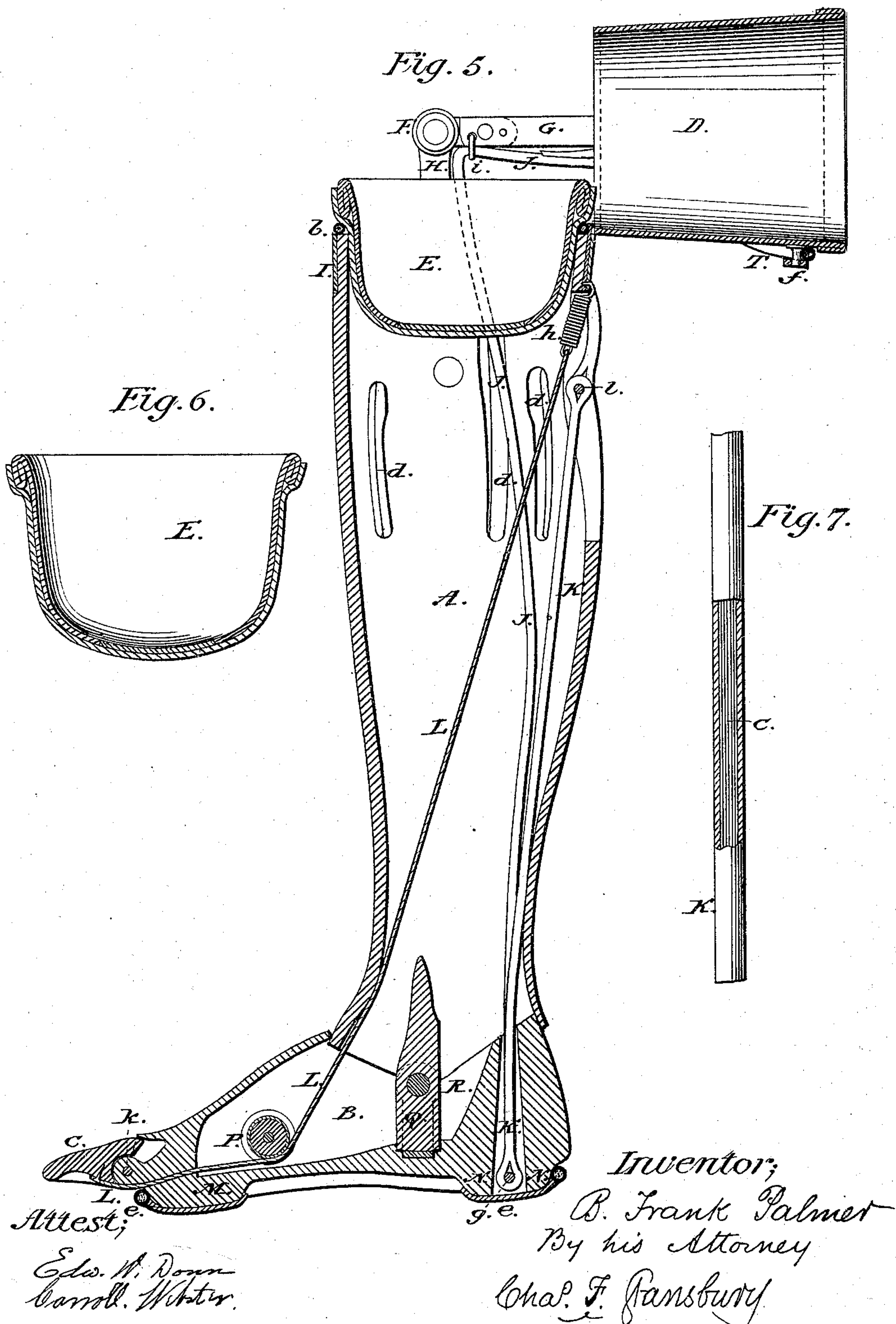
*Edw. W. Down*  
*Carroll Webster*

*Inventor;*  
*B. Frank Palmer*  
*By his Attorney*  
*Chas. F. Mansburt*

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# UNITED STATES PATENT OFFICE.

B. FRANK PALMER, OF PHILADELPHIA, PENNSYLVANIA.

## IMPROVEMENT IN ARTIFICIAL LEGS.

Specification forming part of Letters Patent No. 137,711, dated April 8, 1873; application filed March 14, 1873.

*To all whom it may concern:*

Be it known that I, B. FRANK PALMER, of Philadelphia, in the State of Pennsylvania, have invented Improvements in Artificial Legs; and I do hereby declare the following to be a full and correct description of the same, reference being had to the accompanying drawing, in which—

Figure 1 is a side elevation of an artificial leg having my improvements. Fig. 2 is a bottom view of the foot. Fig. 3 is a longitudinal vertical central section of the foot. Fig. 4 is a transverse vertical section of the foot through the ankle-joint. Fig. 5 is a longitudinal central vertical section of the leg. Fig. 6 is a similar section of the stump-socket. Fig. 7 is a view, partly in section, of my improved heel cord or tendon.

The same part is marked by the same letters of reference in all the figures.

This invention consists in various details of improvement in the construction of the artificial leg heretofore invented and patented by me, and generally known to the public as the Palmer leg. The object of these improvements is to render the leg lighter, stronger, more elastic, and life-like in its motions; to adapt it to support the weight of the wearer in certain cases upon the end of the stump by the introduction of a properly-constructed socket; to give a double support to the foot in certain positions, one of which takes effect before the other, by the introduction of supplementary or auxiliary tendons in addition to and in aid of the cord or tendon representing the natural tendo-Achillis; to improve the movement of the toe, and to give a fine external finish to the limb, while dispensing with the hide by which it was formerly covered.

To enable others to understand and make use of my invention, I will proceed to describe the construction and operation of my improved artificial leg.

In the drawing, A marks the leg proper, which is made hollow, as represented. I prefer to use English willow as the material, as long experience has shown it to be admirably adapted for the purpose. The leg is provided with ventilating-openings *d d*, in the ordinary manner. Instead of covering it with raw calf-skin, as heretofore, I now dispense with that

covering at a considerable saving of weight. To compensate for the loss of support resulting from the removal of the hide, I bind the top rim of the leg, the only joint where such support is required, with brass wire wrapped tightly around it and turned off smooth, forming a band, I, which gives all necessary strength to that part of the limb, while adding but a trifle to its weight. The enamel or finish of any kind is applied directly to the exterior surface of the leg. To the upper rim of the leg are attached the lugs H, forming the lower branch of the knee-joint. These are hinged at F to the upper member G of that joint. The part G is formed in one piece, bowed around the back of the thigh-socket D, as shown in Fig. 1. It is provided with buttons *a f*, to which the upper ends of the tendons J J and T are attached, as seen in Figs. 1 and 5. The thigh-socket D is made of leather, in the ordinary way, and is adapted to the size of the thigh of the wearer.

At its lower end the leg A is attached to the foot B by means of the ankle-joint Q. This joint constitutes one of the important improvements in the construction of the limb. In my former patent this joint consisted of two branches, which ran up the inside of the leg and were united at their lower ends by a bolt which passed through the foot. To support this bolt the foot was made solid and consequently heavy. I now make the ankle-joint in the shape of a horse-shoe, as shown in Fig. 4, place it in the bottom of the foot with its ends projecting upward. Through the eyes in these ends is passed the bolt R, which passes through a block, S, which forms part of and projects down from the leg A, as shown in Figs. 3 and 4. The joint Q is bolted, or otherwise firmly attached, to the foot. This construction enables me to make the foot hollow almost throughout, as shown in Figs. 3 and 5, giving it a lightness hitherto unattainable. Lightness is more important in the foot than in any other portion of an artificial leg, as whatever weight is there acts at the end of a long lever and serves to impede freedom of movement.

The toe-piece C is hinged to the foot at K, and is made with an entering-joint similar to that at the ankle, presenting no break in



the surface. The toe-piece is strengthened by wires run transversely through it to prevent splitting. The toe-tendon L is made of two cords attached to the under cavity of the toe-piece, as shown in Fig. 5. They run around the under side of the pulley P, and are carried up to a point at the top and rear of the leg, where each of the cords is attached to a spiral spring, *h*. The reaction of the spring tends to draw the toe down. K is the main heel-cord or tendo-Achillis. It is made of parallel strands of sewing-silk covered with chamois-skin, as represented in Fig. 7. It is fastened near the bottom of the heel by the pin, and runs up to a point in the back of the calf of the leg, where it is attached by the pin. This main tendon, upon which the greatest strain comes in using the limb, is made larger and stronger than I have heretofore made it, since it is required to be less elastic than formerly, because I now supplement its function by the addition of the two auxiliary tendons J J, placed one on either side of it, as shown in Figs. 4 and 5. The tendons J J diverge at the heel and run up the inside of the leg, and are attached at their upper ends to the buttons *a* on the sides of the bowed joint-piece G. These tendons are so regulated in length as to take the strain ordinarily thrown wholly upon the heel-cord a little before any part of it is borne by that cord. This relieves the heel-cord, assists it in bearing the strain, and enables me to make it stronger and less elastic than heretofore, as before observed. A back cord or tendon, T, is attached to a button, *f*, on the rear side of the thigh-socket D, (see Fig. 5,) and is fastened to the calf of the leg by the pin. The office of this cord is to limit the motion of the knee-joint by a strong and firm yet moderately yielding attachment in place of the rule-joint heretofore used, which was abrupt in its action and often caused a "click," which was highly objectionable. One of the most important improvements looking to the ease and naturalness of the tread and movement of the foot, is presented in the protuberances M and N placed on the bottom of the foot at the ball and heel, respectively. These are most clearly shown in Figs. 2, 3 and 5. They receive and support the weight of the wearer, and allow a lateral movement resembling that of the natural ankle, while unaccompanied by the unsteadiness which has characterized previous attempts to import this movement into the artificial leg. Around these protuberances, after covering them with felt, I place the elastic rubber tubing *e*, arranged as shown in Fig. 2, and over all attach a covering of buckskin or chamois leather. This construction gives softness and elasticity to the tread, while securing the utmost freedom of movement to the foot compatible with steadiness and safety.

To provide for sustaining the weight of the wearer upon the end of the stump I receive the stump in a socket, E, made of leather, and made to conform accurately in length, size,

and shape to the stump which rests in it. This conformity is attained by molding the socket on a cast. I usually make the stump-socket of two thicknesses. A rim is formed at the top which rests upon an elastic cushion, *b*, formed of rubber tubing placed on the upper rim of the leg. The stump-socket is received in a recess of form corresponding with its own in the top of the leg, so that whatever elongation takes place in walking is the result of the drawing out of the socket from the recess. The stump is not withdrawn from the socket E, and there is no feeling of insecurity and no want of precision in the step.

The use of silk covered with chamois leather for the heel-cord is an improvement which I consider important. In my former patents I indicated a preference for the use of catgut for that cord, as I found it much the best material that I had at that time tried; but it is very liable to fray out by friction, is difficult to fasten at the ends, and is greatly affected by changes in the hygrometric condition of the atmosphere. It becomes longer or shorter according to the amount of moisture in the air, and thus introduces an element of uncertainty and insecurity in the use of the limb. Silk I have found to possess the requisite strength, flexibility, and freedom from change.

The formation of the upper member of the knee-joint in one piece, bowed as described, renders the joint lighter and stronger and prevents the lateral spreading which occurs in those made in the old way.

As a covering and support I wind the leg and foot, in whole or in part, with thread. A coating of gum shellac is applied to the wood, and the thread is tensely wound into the gum. To this firm and smooth coating of thread and gum the enamel, principally of shellac, adheres immovably. This covering is not affected by water or varying temperature as a skin glued to the wood would be. Thus, with diminished weight, greater durability and an exquisite finish are obtained.

What I claim as my improvements in artificial legs, and desire to secure by Letters Patent, is—

1. The double toe-cord L, running in the pulley P, and attached at the rear and back of the leg, as described and shown.
2. The toe-piece C, strengthened as described, and forming a close joint with the foot, as shown.
3. The protuberances M N on the bottom of the foot, as and for the purpose described.
4. In combination with the protuberances M N, the elastic cushion *e e*, formed of rubber tubing, and arranged substantially as and for the purpose stated.
5. The ankle-joint Q, made of a curved or horseshoe form, as represented, and placed in the bottom of the foot, with its ends projecting upward to receive the ankle-bolt, all as and for the purpose described.
6. The heel-tendon K, made of strands of silk covered with leather, as described.



7. The supplemental or auxiliary tendons J J, arranged, attached, and operating as set forth.

8. The covering of thread and gum shellac, for the purpose set forth.

9. The stump-socket E, made of leather, molded to conform to the stump, and resting by a shoulder on an elastic cushion about the upper rim of the leg, and fitting snugly, but so as to be easily withdrawn, in a recess of corresponding shape in the top of the leg, all constructed and arranged substantially as set forth.

10. The bowed joint G, constructed, arranged, and operating as described.

11. The confining band or hoop I, formed of wire wound tightly around the leg and turned off on the surface, as and for the purpose specified.

The above specification of my said invention signed and witnessed at Philadelphia this 12th day of March, A. D. 1873.

B. FRANK PALMER.

Witnesses:

T. E. MERCHANT,

JOHN H. MCQUIGGAN.