S. VINCENTI.

ARTIFICIAL FOOT.

APPLICATION FILED APR. 5, 1918.

1,289,580.

Patented Dec. 31, 1918.

4 SHEETS—SHEET 1.

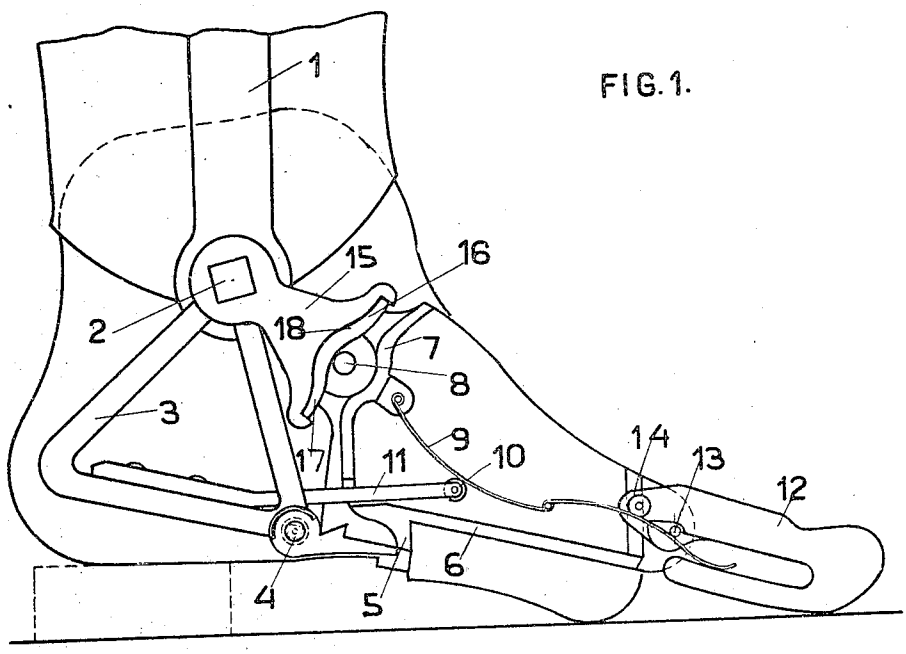


FIG. 1.

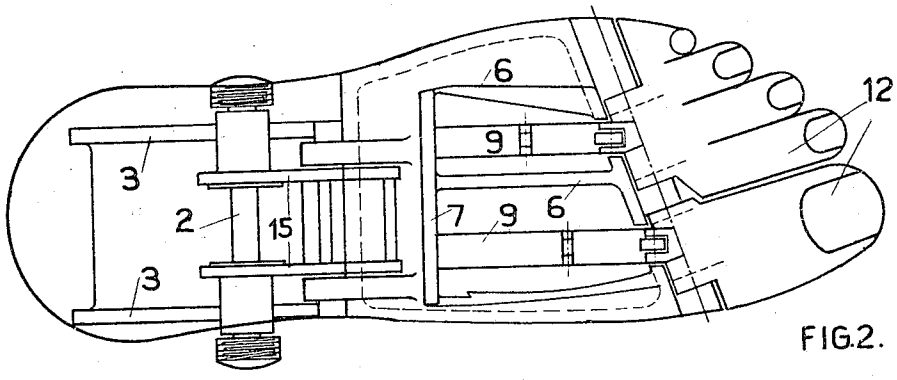


FIG. 2.

INVENTOR:
Stanislaw Vincenti
By Wm Wallace White
ATT'Y.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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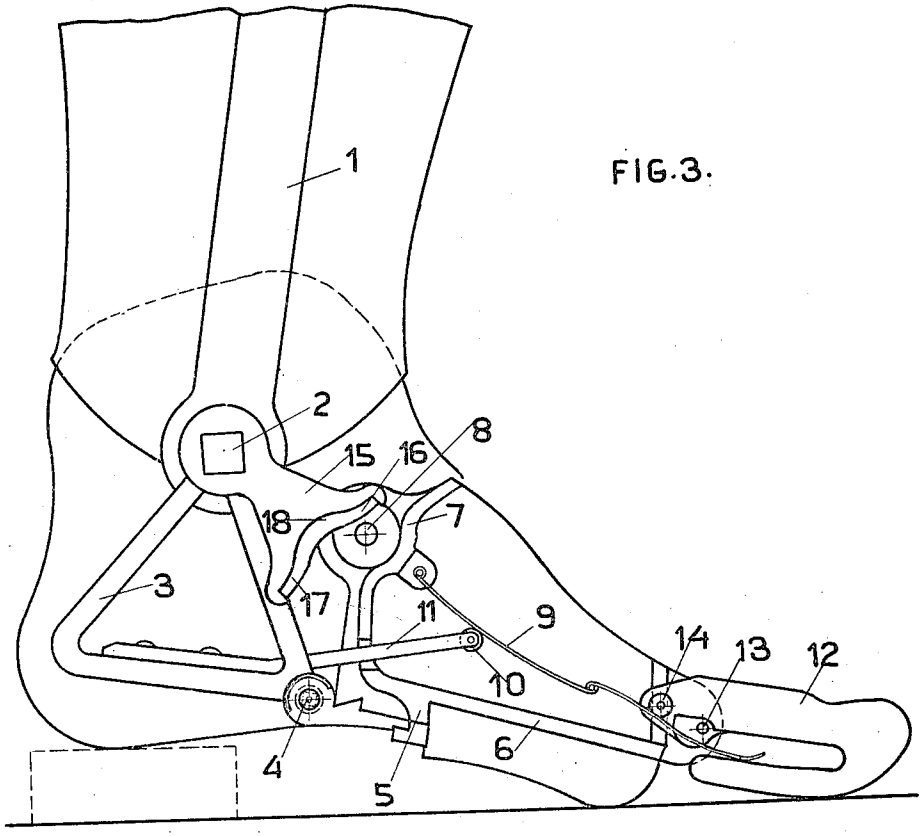


FIG.3.

INVENTOR:
Stanislaw Vincenti
By Wm Wallace White
ATTY.

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4 SHEETS—SHEET 3.

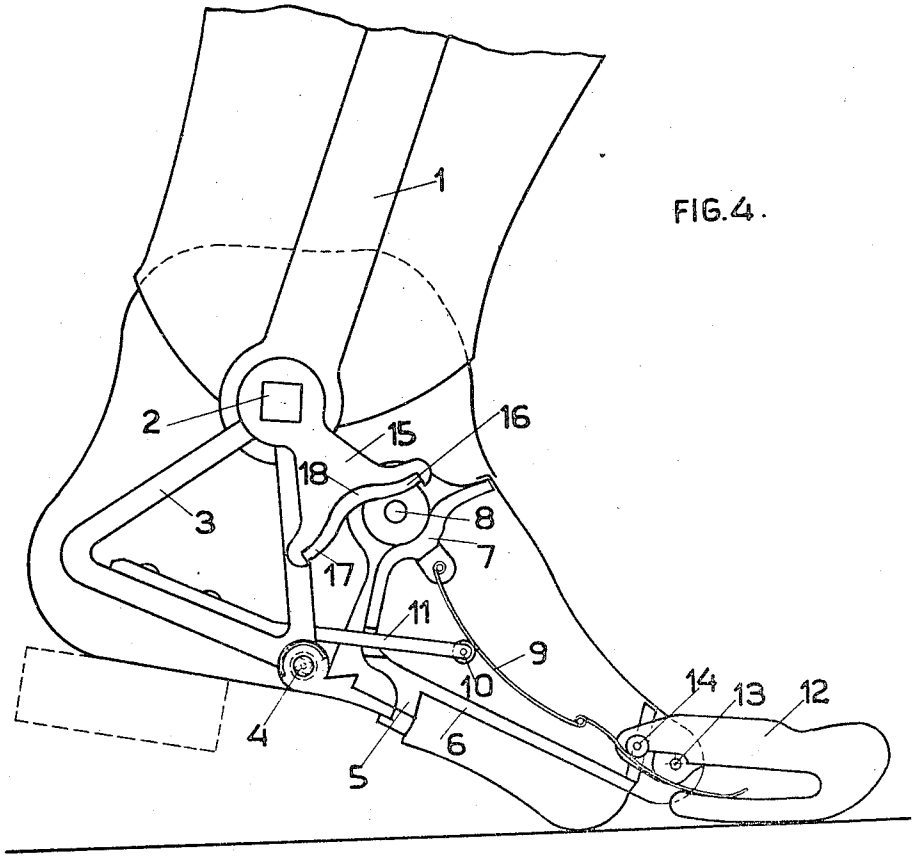


FIG. 4.

INVENTOR:
Stanislaw Vincenti
By
Wm Wallace White
ATTY.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

S. VINCENTI.

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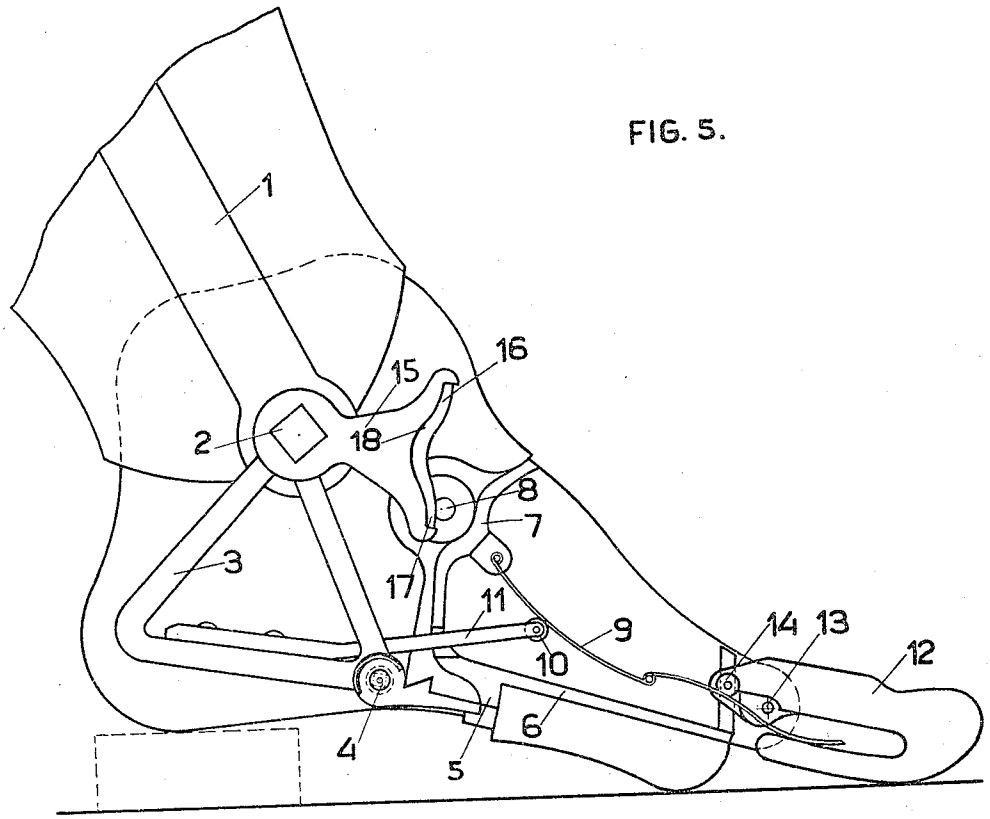
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4 SHEETS—SHEET 4.

FIG. 5.



INVENTOR:.
Stanislaw Vincenti
By Wm Wallace White
ATTY.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

STANISLAW VINCENTI, OF GENEVA, SWITZERLAND.

ARTIFICIAL FOOT.

1,289,580. Specification of Letters Patent. Patented Dec. 31, 1918.

Application filed April 5, 1918. Serial No. 226,956.

To all whom it may concern:

Be it known that I, STANISLAW VINCENTI, a citizen of Switzerland, and residing at Geneva, Switzerland, have invented certain new and useful Improvements in Artificial Feet, of which the following is a specification.

My invention relates to an artificial foot pivoted to a shank, by the swinging movements of which the articulated parts of the foot are moved.

A primary object of the invention is to provide that the swinging movement of the leg or shank is used for moving the parts of the foot relatively to one another in such a manner that at the commencement of a step the rear part of the foot is lifted with the shank for obviating limping, and so that, when placing the extended foot on the ground, the middle part of the foot is lowered for immediately obtaining a large area of support and also for imitating the movement of the natural foot, whereby the foot can take up every natural position.

To this end my improved artificial foot comprises a pressure lever provided with curved operative faces which is so connected with the shank and actuates the articulate parts of the foot in such a manner that the described movements result.

The invention consists in the construction, arrangement and combination of parts described hereinafter and pointed out in the claims.

One illustrative embodiment of the invention is represented by way of example in the accompanying drawing, wherein:—

Figure 1 is a diagrammatic side elevation of the skeleton of the foot, and

Fig. 2 is a top plan view thereof;

Fig. 3 shows the foot at the commencement of a step forward, the shank being shown slanting forward,

Fig. 4 shows the foot advancing with the heel raised, and

Fig. 5 shows the foot at the end of the step after being placed on the ground, but while the shank is still slanting backward.

Referring to the drawings, the outer shape of the foot is not material to the invention; any suitable means may be used for giving the foot a natural shape. It may be made of felt, or pneumatic cushions or pads may be provided, particularly on the sole, for causing better distribution of the pressure when treading on the ground.

For attaching the foot to the stump of the leg I use bars 1 besides other known means, not shown, such as leather straps and the like. These bars extend upward at the two sides of the stump of the shank or, if the femur has been amputated, they will be jointed at the knee and extend to the thigh. The two bars 1 carry at their lower ends a shaft 2 rigidly connected with them. This shaft is squared at two places for receiving the pressure lever 15, and it freely carries the heel part 3 which is shown as a triangular frame, but may be shaped otherwise if desired. This heel part 3 is pivotally connected at 4 with the instep or middle part, comprising the frame 5 and, corresponding to the shape of the foot, an approximately horizontal, slightly downwardly directed part 6 and an upwardly directed part 7. An anti-friction roller 8 is mounted on this upwardly directed part 7; this part also carries several springs 9 which bear on anti-friction rollers 10 carried by arms 11 fast on the heel frame 3. These springs 9, which preferably consist of two springs pivotally connected together, extend into the toe part 12 which is pivotally connected at 13 with the instep frame. The toe part 12 which, as shown in Fig. 2, may consist of two parts located beside one another, carries anti-friction rollers 14 located in front of and above the joints 13. These rollers 14 press on the front ends of the springs 9, so that when the toe part is rocked about its fulcrum, these springs are tensioned by means of the rollers 10 and 14, so that they tend to return the toes automatically into their normal position.

Two pressure levers 15, firmly connected with the bars 1, bear against the roller 8, so that whenever the angle of inclination of the bars 1 changes the levers 15 must also move. A pressure member 18 having a cam face 16, 17 is exchangeably mounted in suitable guides on these levers.

As clearly shown in the drawings the joint 4 connecting the two parts 3 and 5 has only a very little play, so that the two parts can rotate only a relatively small angle relatively to one another.

The action of the described foot is as follows:—

At the commencement of a step when the foot moves from the position shown in Fig. 1 into that shown in Fig. 3, the cam face 16 of the lever 15 acts on the roller 8, and the distance between the roller and the axis of

the shaft 2 is increased. The ball 6 of the instep part still rests firmly on the ground under the full pressure of the body. Consequently, the instep part 5 cannot yield to the pressure of the bars 1 through the lever 15 on the roller 8, so that the shaft 2 and the bars 1 are pressed backward in order to increase the distance between the parts 2 and 8. Hence the parts 3 and 5 turn relatively to each other in the joint 4 and since, owing to the small amount of play in this joint, the movement in the joint is very quickly finished, a pressure is exerted which tends to lift the joint 4 a little and with it the parts connected therewith, particularly the shaft 2 and the bars 1 on the one hand, and the part 7 of the instep frame on the other. The fulcrum for this movement may be considered to be the ball part of the instep, this being firmly placed on the ground at this instant and taking up almost the entire pressure of the body carried by the foot, because during this forward movement of the shank the heel is relieved to a certain extent even if the heel has not yet been completely lifted from the ground.

During this rotation of the heel part 3 relatively to the instep part the rollers 10 mounted on the arms 11 of the heel part move upward and press against the springs 9 from below, so that these are tensioned, as shown in Fig. 3.

On the shank moving farther forward for the purpose of advancing, the parts 3 and 5 at first remain stationary relatively to one another and are then lifted conjointly, the toe joint being bent still more as the heel rises from the ground, as shown in Fig. 4. At this moment the load bears substantially on the toes now fully bent. The springs 9 are now severely tensioned at their front ends owing to rollers 14 pressing from above on the front end of the springs.

When the foot is lifted and swings freely in the air, the parts moved relatively to one another take up their normal position as shown in Fig. 1. The toe part is pressed downward by the front end of the springs 9, so that it is again located in the direction of the longitudinal axis of the instep or middle part. On the other hand, the tensioned springs 9 act in such a manner on the heel part by means of the rollers 10 and the arms 11 that the backward relative movement of the two parts 3 and 5 begins. In this position, however, the heel part 3 cannot yield further, as its movement relative to the part 5 is checked by the joint 4. Consequently, the effect of the pressure of the springs 9 on the roller 10 is to lift the instep part, the roller 8 running along the cam face 16 and finally arriving in the middle position as shown in Fig. 1.

The forward movement of the step is completed in this position, in which the foot is located at right-angles to the longitudinal axis of the leg, and the foot is finally placed on the ground when the knee is bent straight and the leg lowered. The heel located slantwise first touches the ground and, owing to the foot beginning to be loaded again, the bars 1 are turned backward relatively to the foot. The levers 15 then act again on the roller 8 of the instep, but now the cam face 17 operates. Owing to the heel being supported, the instep part rocks about the axis 4 and, consequently, the instep and toes descend to the ground, and the position shown in Fig. 5 obtains. It is seen, therefore, that almost immediately after the foot touches the ground the entire foot is planted firmly on the ground and affords an effective and reliable support.

An essential feature of the invention is thus the novel connection between the heel and instep parts by virtue of which, solely owing to the natural movement of the leg when walking, the leg is lifted at the beginning of a step on the one hand, and on the other hand, at the end of the step the instep and toes are moved downward for obtaining a secure foot-hold.

Another advantage of the invention is that other movements of the foot, *e. g.* that when riding, when rowing seated on sliding seats, and the like, can be imitated simply by substituting the cam member 18 having the cam faces 16 and 17 by other cam members having faces adapted to produce the required movements. For as will be readily understood from the above and from the drawings, the shape of these cams may be such as to produce any desired movement of the instep part when bending and stretching the leg, so that the artificial foot can be adapted to the natural gait of any person.

I claim:—

1. In an artificial foot, the combination with a shaft and bars fixed to said shaft for attachment to a leg, of a heel member pivotally mounted on the said shaft, an instep member pivoted to the heel member, a controlling cam rigidly connected to the said shaft and coacting by the swinging movement of the leg with the said instep member, a toe member pivotally connected to the instep member, and means for regulating the relative position of the heel member, the instep member, and the toe member to each other.

2. In an artificial foot, the combination with a shaft and bars fixed to the shaft for attachment to a leg, of a heel member pivotally mounted on the said shaft, an instep member pivoted to the heel member, a controlling cam rigidly connected to the said shaft, the instep member being provided with an upwardly extending arm formed on the instep member, an antifriction roller mounted on said arm and coacting with said

controlling cam, a toe member pivotally connected to the instep member, and means for regulating the relative position of the heel member, the instep member, and the toe member to each other.

3. In an artificial foot, the combination with a shaft and bars fixed to said shaft for attachment to a leg, of a heel member, an instep member, a controlling cam rigidly connected to the said shaft, an upward extending arm formed on said instep member, an antifriction roller mounted on said arm, the said controlling cam coacting with the said roller, a toe member being pivotally connected to the instep member, the said heel member having the form of a triangular frame, one corner of the latter being pivotally connected to the said shaft, one other corner adjacent to the said instep member being pivoted to the heel member but rotatable with the instep member only in a little extent, and means for regulating the relative positions of the heel member, the instep member and the toe member to each other.

4. In an artificial foot, the combination with a shaft and bars fixed to said shaft for attachment to a leg, of a triangularly shaped heel member pivotally mounted on the said shaft, an instep member pivoted to the heel member, a controlling cam rigidly connected to the said shaft and coacting by the swinging movement of the leg with the said instep member, a toe member pivotally connected to the instep member, a two-part jointed spring having one end connected to the instep member and its other end taking into the toe member, a first pressure roller supported by the heel member and influencing the one part of the said two-part jointed spring, and a second pressure roller supported by the toe member and influencing the other part of the spring.

5. In an artificial foot, the combination with a shaft and bars fixed to the shaft for attachment to a leg, of a heel member pivotally mounted on the said shaft, an instep member pivoted to the heel member, a controlling cam rigidly connected to the said shaft, an upwardly extending arm formed on the instep member, an antifriction roller mounted on said arm, the said controlling cam coacting with the said roller, a toe member pivotally connected to the instep member, a two-part jointed spring having one end connected to the said upwardly extending arm of the instep member and its other end taking into the toe member, two pressure rollers, an arm protruding from the heel member and supporting one of said rollers, the last-mentioned roller pressing against the lower side of the one part of the said spring, and the other of the said rollers being supported by the toe member and pressing against the upper side of the other part of the spring.

6. In an artificial foot, the combination with a shaft and bars fixed to the shaft for attachment to a leg, of a heel member pivotally mounted on the said shaft, an instep member pivoted to the heel member, a lever rigidly connected to the said shaft, a controlling cam piece mounted on said lever, an upwardly extending arm formed on the instep member, an antifriction roller mounted on said arm, the said controlling cam piece coacting with the said roller, a toe member pivotally connected to the instep member, and means for regulating the relative position of the heel member, the instep member and the toe member to each other.

7. In an artificial foot, the combination with a shaft and bars fixed to the shaft for attachment to a leg, of a heel member pivotally mounted on the said shaft, an instep member pivoted to the heel member, a lever rigidly connected to the said shaft, a controlling cam piece with two cam surfaces mounted on said lever, an upwardly extending arm formed on the instep member, an antifriction roller mounted on said arm, the said controlling cam piece acting with the one cam on the said roller during the movement of the leg toward the one direction, and with the other cam on the roller during the movement of the leg toward the other direction, a toe member pivotally connected to the instep member, and means for regulating the relative position of the heel member, the instep member and the toe member to each other.

In testimony, that I claim the foregoing as my invention, I have signed my name in the presence of two subscribing witnesses.

STANISLAW VINCENTI.

Witnesses:

MAURICE PREGER,

CHARLES POSNANSKI.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."