TO: KSI/Scientific & Technical Information Division  
Attn: Miss Winnie M. Morgan

FROM: GP/Office of Assistant General Counsel for Patent Matters

SUBJECT: Announcement of NASA-Owned U.S. Patents in STAR

In accordance with the procedures agreed upon by Code GP and Code KSI, the attached NASA-owned U.S. Patent is being forwarded for abstracting and announcement in NASA STAR.

The following information is provided:

U.S. Patent No.: 4,051,558

Government or Corporate Employee: U.S. Government

Supplementary Corporate Source (if applicable): 

NASA Patent Case No.: ARC-10,916-1

NOTE - If this patent covers an invention made by a corporate employee of a NASA Contractor, the following is applicable:

YES ☐  NO ☒

Pursuant to Section 305(a) of the National Aeronautics and Space Act, the name of the Administrator of NASA appears on the first page of the patent; however, the name of the actual inventor (author) appears at the heading of column No. 1 of the Specification, following the words "...with respect to an invention of ..."

Bonnie L. Henderson

Enclosure
MECHANICAL ENERGY STORAGE DEVICE
FOR HIP DISARTICULATION

Inventor: Wilbur C. Vallotton, Los Gatos, Calif.

Assignee: The United States of America as represented by the United States National Aeronautics and Space Administration, Washington, D.C.

Filed: June 30, 1976

Abstract
An artificial leg includes a trunk socket, a thigh section hingedly coupled to the trunk socket, a leg section hingedly coupled to the thigh section and a foot section hingedly coupled to the leg section. A mechanical energy storage device, such as a spring, is operatively associated with the artificial leg for storage and release of energy during a normal walking stride of the user. More particularly, energy is stored in the mechanical energy storage device during a weight-bearing phase of the walking stride when the user's weight is on the artificial leg and energy is released during a phase of the normal walking stride, when the user's weight is removed from the artificial leg. The stored energy is released from the energy storage device to pivot the thigh section forwardly about the hinged coupling thereof to the trunk socket. A dash-pot is coupled between the lower end of the thigh section and the foot section for damping flexion of the knee joint after a certain predetermined extent of ankle flexion is achieved to derive a more normal stride and cadence.

8 Claims, 5 Drawing Figures
Fig. 3

MOMENT ABOUT HIP JOINT (IN-LB)

SPRING FORCE #5

ANGLE FROM VERTICAL

Fig. 4

Fig. 5
DEPARTMENT OF COMMERCE
INVENTOR

In one feature of the present invention, an artificial leg is provided which includes a trunk socket, a thigh section, a leg section and a foot section, said sections of the artificial leg being hingedly coupled together via the intermediary of a hip joint, a knee joint and a foot joint, respectively. An energy storage device is coupled between the trunk socket and at least one of said thigh and leg sections for storage of energy during one phase of the normal walking stride and release of this energy during another phase to flex the hip joint, much as a normal hip joint flexes.

In another feature of the present invention, a dash-pot is coupled between the thigh section and the foot section to damp flexion of the knee joint after a predetermined flexion of the foot joint is obtained to derive a more nearly normal stride and cadence.

Other features and advantages of the present invention will become apparent upon a perusal of the following specification taken in connection with the accompanying drawings wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view, partly in section, of an artificial limb incorporating features of the present invention, such limb being shown in the weight bearing phase of a user's stride.

FIG. 2 is a view similar to that of FIG. 1 depicting the knee flexing phase and the swing through phase of the user's stride.

FIG. 3 is a plot of moment about the hip joint versus angle θ from the vertical for the thigh section depicting the spring force of the energy storing device and the resultant moment produced on the thigh section about the hip joint for the artificial leg of the present invention.

FIG. 4 is an enlarged sectional view of a portion of the structure of FIG. 1 delineated by line 4—4, and FIG. 5 is an enlarged sectional view, partly in block diagram form, of the dash-pot portion of the artificial leg delineated by line 5—5 of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1 there is shown an artificial leg 11 incorporating features of the present invention. The artificial leg 11 includes a conventional trunk socket portion 12 for receiving the lower trunk of the body of the user and for affixing the artificial leg 11 to the trunk of the user. A hollow thigh section 13 is hingedly coupled to the trunk socket 12 via the intermediary of a pivotable knee joint 16. A hollow leg section 15 is hingedly coupled to the lower end of the thigh section 13 via the intermediary of a pivotable knee joint 16. A foot section 17 is hingedly coupled to the lower end of the leg section 15 via the intermediary of a pivotable foot joint 18.

An energy storage device 19 is coupled between the hip joint and a pivotable joint 21 at the upper end of the leg section 15 just rearward of the knee joint 16 via the intermediary of a floating link-type connection. More particularly, the energy storage device 19 is pivotably connected at its lower end at 21 to the leg section 15, whereas its upper end is pivotably connected at 22 to the lower end of a link 23 which in turn is pivotably connected at its upper end to the hip joint 14. Link 23 includes an adjustable rubber stop portion 24 which abuts at its rearward-most extremity of movement about the hip joint 14 against the lower surface of the trunk socket 12. When the artificial leg 11 is in the weight-bearing phase as shown in FIG. 1, the stop 24 abuts the socket 12, the intermediate joint 22 takes a position

In another feature of the present invention, a dash-pot is coupled between the thigh section and the foot section to damp flexion of the knee joint after a predetermined flexion of the foot joint is obtained to derive a more nearly normal stride and cadence.

Other features and advantages of the present invention will become apparent upon a perusal of the following specification taken in connection with the accompanying drawings wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view, partly in section, of an artificial limb incorporating features of the present invention, such limb being shown in the weight bearing phase of a user's stride.

FIG. 2 is a view similar to that of FIG. 1 depicting the knee flexing phase and the swing through phase of the user's stride.

FIG. 3 is a plot of moment about the hip joint versus angle θ from the vertical for the thigh section depicting the spring force of the energy storing device and the resultant moment produced on the thigh section about the hip joint for the artificial leg of the present invention.

FIG. 4 is an enlarged sectional view of a portion of the structure of FIG. 1 delineated by line 4—4, and FIG. 5 is an enlarged sectional view, partly in block diagram form, of the dash-pot portion of the artificial leg delineated by line 5—5 of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1 there is shown an artificial leg 11 incorporating features of the present invention. The artificial leg 11 includes a conventional trunk socket portion 12 for receiving the lower trunk of the body of the user and for affixing the artificial leg 11 to the trunk of the user. A hollow thigh section 13 is hingedly coupled to the trunk socket 12 via the intermediary of a pivotable knee joint 16. A hollow leg section 15 is hingedly coupled to the lower end of the thigh section 13 via the intermediary of a pivotable knee joint 16. A foot section 17 is hingedly coupled to the lower end of the leg section 15 via the intermediary of a pivotable foot joint 18.

An energy storage device 19 is coupled between the hip joint and a pivotable joint 21 at the upper end of the leg section 15 just rearward of the knee joint 16 via the intermediary of a floating link-type connection. More particularly, the energy storage device 19 is pivotably connected at its lower end at 21 to the leg section 15, whereas its upper end is pivotably connected at 22 to the lower end of a link 23 which in turn is pivotably connected at its upper end to the hip joint 14. Link 23 includes an adjustable rubber stop portion 24 which abuts at its rearward-most extremity of movement about the hip joint 14 against the lower surface of the trunk socket 12. When the artificial leg 11 is in the weight-bearing phase as shown in FIG. 1, the stop 24 abuts the socket 12, the intermediate joint 22 takes a position