

Sept. 18, 1951

J. G. CATRANIS

2,568,053

KNEE LOCK MECHANISM FOR ARTIFICIAL LEGS

Filed Oct. 7, 1948

3 Sheets-Sheet 1

FIG. 1

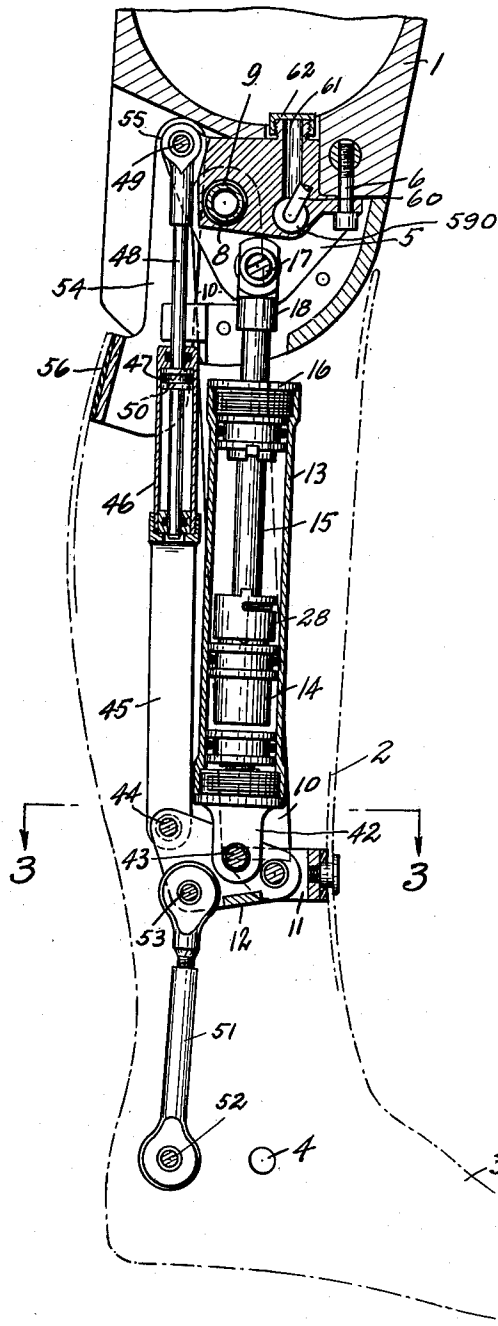


FIG. 2

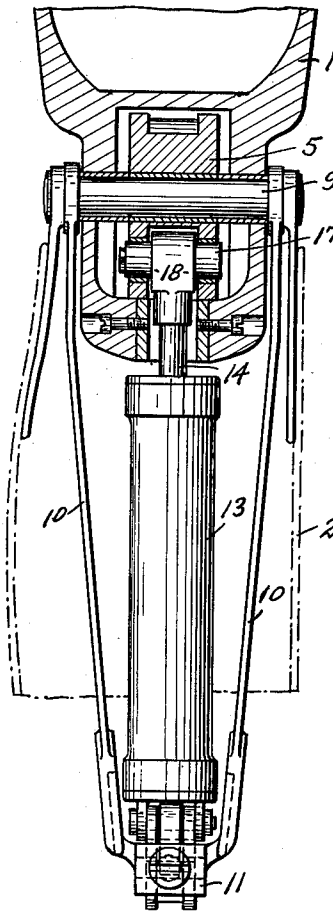
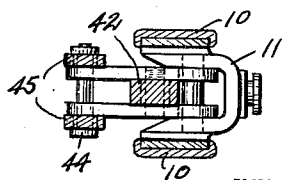


FIG. 3



INVENTOR:

John G. Catranis,

BY

Bodell & Thompson,

ATTORNEYS.

Sept. 18, 1951

J. G. CATRANIS

2,568,053

KNEE LOCK MECHANISM FOR ARTIFICIAL LEGS

Filed Oct. 7, 1948

3 Sheets-Sheet 2

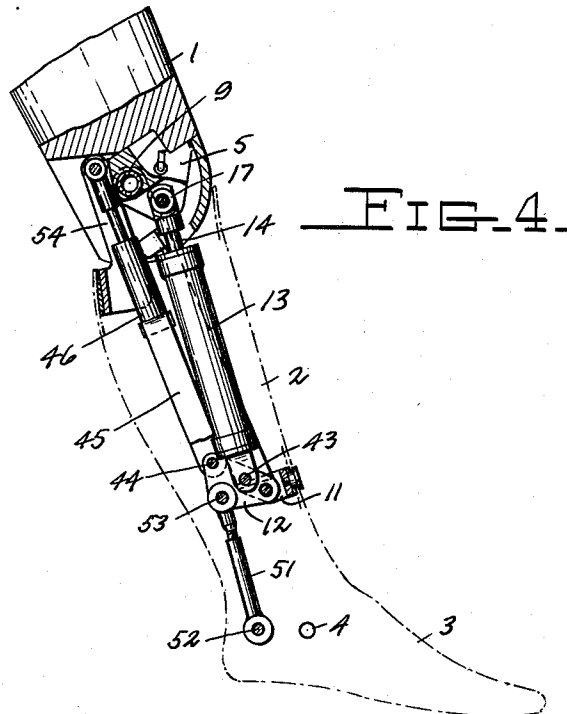
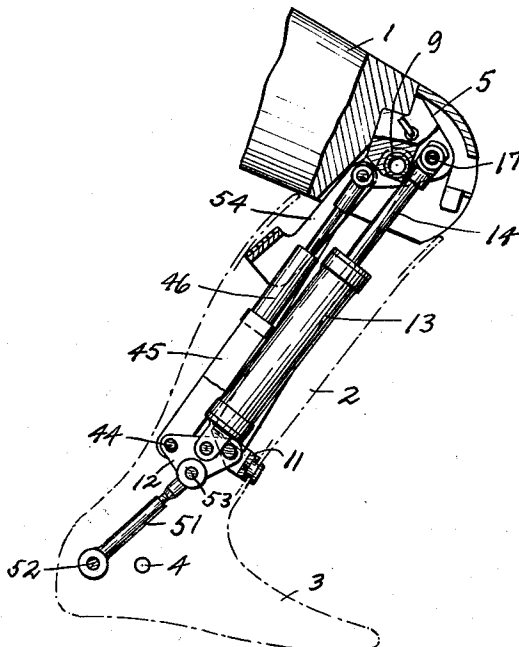


FIG. 5



INVENTOR:
John G. Catranis,
BY
Bodell & Thompson
ATTORNEYS.

Sept. 18, 1951

J. G. CATRANIS

2,568,053

KNEE LOCK MECHANISM FOR ARTIFICIAL LEGS

Filed Oct. 7, 1948

3 Sheets-Sheet 3

FIG. 6

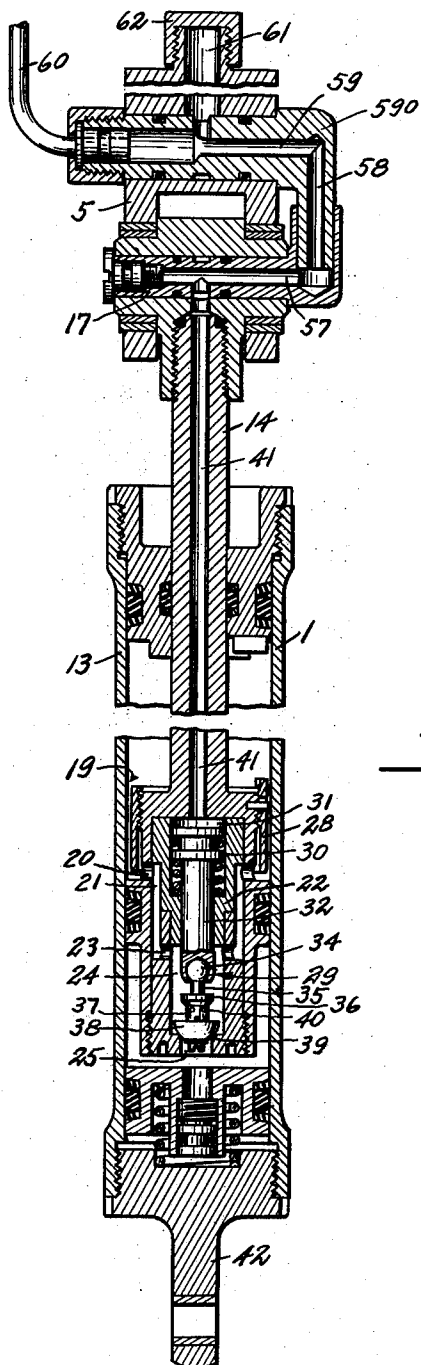


FIG. 7

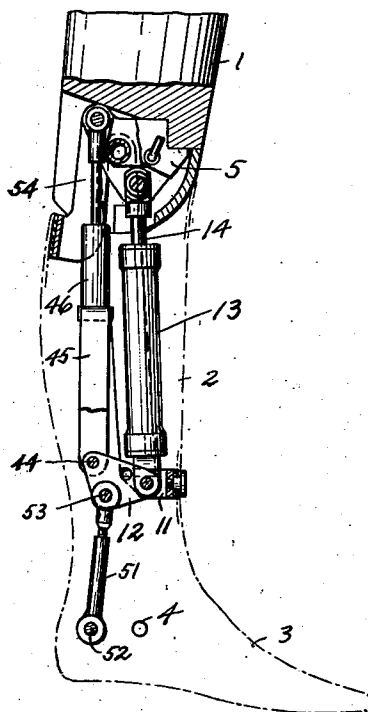
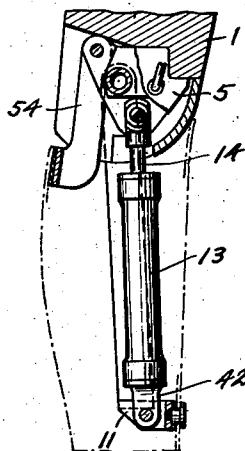


FIG. 8



INVENTOR:
John G. Catranis,
BY
Bodell & Thompson
ATTORNEYS.

UNITED STATES PATENT OFFICE

2,568,053

KNEE LOCK MECHANISM FOR ARTIFICIAL LEGS

John G. Catranis, Syracuse, N. Y.

Application October 7, 1948, Serial No. 53,200

2 Claims. (Cl. 3—2)

1

This invention relates to a knee lock mechanism for artificial legs for above-the-knee amputees, and has for its object a self-contained, hydraulic knee lock mechanism comprising standardized parts, some or all of which are used in or attached to the stump socket and the lower leg of conventional artificial legs, to fulfill the different individual conditions and requirements of the amputees and of the automatic or unconsciously operated knee lock controls, selected as best suited to the individual amputees.

A conventional artificial leg comprises a stump receiving socket, a lower leg unit or body hinged by a knee joint to the lower end of the socket, the lower leg having a foot which, in some cases, is hinged to the lower leg by an ankle joint. The knee lock operates to retard and hold the leg from collapsing, or buckling, at the knee joint when the heel contacts and when the foot is planted on the walking surface in taking a step on the artificial leg, and to release the knee lock preparatory to lifting the foot off the surface to take a new step, and thus permit the lower leg to swing or free wheel about the knee joint from a rearward inclined position relatively to the hip, or the body, to a forward inclined position where the foot is again planted on the walking surface. Automatic or unconsciously operated controls may be of different types operated to progressively throttle and to release the dash pot action of the hydraulic knee lock by the action of the stump, or muscles thereof, in the stump socket.

The unitary, or self-contained, knee lock mechanism, constituting the subject matter of this invention, comprises an upper support or bearing bracket attachable to the lower end of the stump socket, a depending frame hinged at its upper end by a knee joint to the upper support or bracket, a second or lower support applied to the body of the lower leg structure between the ends thereof within the same, a hydraulic dash pot link pivoted at its upper end to the upper support or bracket at a point radially spaced from the knee joint hinge, and at its lower end to the lower support, the link including a cylinder element and a piston and rod element working in the cylinder element, one element having a by-pass connecting opposite ends of the cylinder element, a normally fully-open throttle valve in the by-pass operable progressively to closed position, and operating means for the valve operated by relative action of the stump, or the muscles thereof, and the socket to close the throttle valve when the stump

2

is shifted about the hip joint through different angles and when the foot is planted on the walking surface, and to open the valve and release the knee lock when the stump is shifted to lift the foot off said surface. In other words, the self-contained knee lock mechanism comprises upper and lower supports attachable to the lower end of the stump socket and to the lower leg, a frame between the supports and hinged by a knee joint or pin to the upper bracket and knee lock mechanism carried by the supports.

The invention consists in the novel features and in the combinations and constructions hereinafter set forth and claimed.

In describing this invention, reference is had to the accompanying drawings in which like characters designate corresponding parts in all the views.

Figure 1 is a side elevation, partly in section, of a knee lock mechanism, the conventional stump socket and lower leg body structure being also shown in section.

Figure 2 is a fragmentary elevation, partly in section, looking to the left in Figure 1.

Figure 3 is a sectional view, partly in section, on line 3—3, Figure 1.

Figure 4 is a view showing the operation of the knee lock, the parts being shown in their position occupied when the foot is planted on the floor at the beginning of a new step.

Figure 5 is a similar view showing the operation of the knee lock when descending a stairs, or an inclined surface, with the weight on the artificial leg.

Figure 6 is an enlarged detail view of the cylinder and piston of the knee lock, the contiguous parts of the hydraulic control being also shown.

Figure 7 is a view, similar to Figure 1, showing a slightly different arrangement of the parts of the knee lock mechanism.

Figure 8 is a view, similar to Figure 7, of a second modification of the arrangement of the parts of the knee lock mechanism.

1 and 2 designate, respectively, the stump receiving socket and the lower leg structure of a conventional artificial leg, the foot 3 being of the type pivoted by an ankle joint 4 to the leg. The hydraulic mechanism standardized to fit, or be usable with conventional artificial legs, comprises an upper support or bracket 5 fixedly attachable, as by screws 6, to the lower end of the stump socket 1 and having a bearing opening, as 8, for the knee pin 9, a frame 10 consisting of members mounted at their upper ends on the

3

knee pin, and at their lower ends on a second or lower support attachable to the body of the lower leg structure between its ends, a hydraulic link pivoted at its upper end to the upper support or bracket at a point radially spaced from the knee joint hinge, or knee pin, and its lower end to the lower support. The link is a dash-pot of the cylinder and piston type formed with a by-pass from one end of the cylinder to the other end, and having throttle valving in the by-pass operable progressively toward closed position and out of closed position by means operated by the action of the stump in the socket to open and close the throttle valve. The lower support, attachable to the lower leg structure on the inner side thereof, comprises a bracket 11 for attachment to the wall of the body of the lower leg structure, and a lever 12 pivoted to the bracket. The hydraulic link comprises a cylinder 13 and a piston 14 therein having its rod 15 extending through the head 16 at the upper end of the cylinder and pivoted at 17 to the bracket 5 eccentric to the axis of the knee pin 9. The upper support or bracket 5 is here shown as bifurcated and the piston rod has a head 18 mounted on the pivot 17 between the bifurcations.

In the illustrated embodiment of the invention the by-pass, connecting opposite ends of the cylinder, is formed in the piston. The structure of the piston and the by-pass and of the throttle valve per se form no part of this invention and they may be of any suitable construction. They constitute the subject matter of another invention. As seen in Figure 6, the by-pass includes an annular passage 19 around the upper portion of the piston, radial ports 20 leading from the annular passage 19 inwardly into lengthwise internal passages 21 around the throttle valve casing 22 to inwardly extending radial ports 23 into an axial passage 24 which communicates through a port 25 with the end of the cylinder below the piston. An axially adjustable sleeve 28 threads on the upper end of the piston and forms the inner wall of the annular chamber 19, it being initially axially adjusted, or set, to vary the effective size of the ports 20.

The throttle valve designated generally 29 is located in an axial bore in the casing 22 and includes a piston head 30 movable in a chamber 31 in the upper end of the bore of the casing 22, a stem 32 extending downwardly through the casing and connected by a flexible joint 34 to a stem 35 which carries a valve head 36 having a depending tubular portion 37 slidable in a valve head 38 coacting with the valve seat 39 in the port 25. The valve head 36, or the hollow tubular portion 37 thereof, is formed with a plurality of inlet ports 40 opening into the interior of the tubular portion and progressively closeable as the throttle valve moves downwardly through the valve head 38 until the valve head 36 seats on the seat provided therefor on the valve head 38 and thus fully closes the throttle valve. The passage of the tubular portion 37 opens into the lower end of the cylinder 13. The chamber 31 is connected in a hydraulic operating system to an axial bore 41 in the piston rod 14, as will be presently described.

As before stated, however, the construction of the cylinder, piston, by-pass and throttle valve per se, form no part of this invention, the throttle valve and structure of the piston providing the by-pass being the subject matter of another invention.

4

In the form of the invention shown in Figure 1, the lower end of the cylinder is provided with a lug 42 depending from the head at the lower end thereof, the lug being pivoted at 43 to the lever 12 of the lower support. The other end of the lever 12 is pivoted at 44 to one end of a link 45 of a cylinder 46 of a shock absorbing dash pot of usual construction having a piston 47 therein, the rod 48 of which is pivoted at 49 to the upper support 5. In this dash pot, the piston merely has a transfer passage 50 therethrough from the upper side to the lower side thereof. Also, in the form shown in Figure 1, the action of the knee lock cylinder and piston 13 and 14 is coordinated with, or modified by, a connection with the foot 3 and operated by the change of angular position of the foot 3 about the ankle joint 4, one operation being shown in Figures 4 and 5. This connection consists of a link 51 pivoted at its lower end at 52 to the heel of the foot in the rear of the ankle joint 4, and at its upper end at 53 to the lever 12. The purpose of the dash pot, consisting of the cylinder 46 and the piston 47, is to retard the movement of the foot 3 about the ankle joint, or the flexing of the foot during the walking cycle. That is, to let the foot tend to take different angular positions without slapping during the walking cycle. The means for performing the retarding function per se forms no part of the invention, whether the means are dash pots, or slip friction telescoping joints.

In the form shown in Figure 7, the lower end of the cylinder 13 is pivoted to the pivot between the bracket 11 and the lever 12 so that the pivotal movement of the lever is not subject to the action of the piston 14 in the cylinder 13. Thus, the cylinder 13 is interchangeably connectable with the bracket 11, or the lever 12 of the lower support.

In the form shown in Figure 8, a portion of the standardized knee lock mechanism is shown as applied to a leg in which only the hydraulic knee lock cylinder and piston is used between the upper and lower supports.

The pivotal movement or bending of the lower leg about the knee joint is limited beyond a straight position of the socket and lower leg by a stop arm 54 secured to the upper bearing support bracket 5 at 55 and coacting with a stop surface 56 on the outer casing or body of the lower leg structure.

The hydraulic control system consists of the passage 41 in the piston rod 14 communicating through conduits with the control member activated by relative movement of the muscles of the stump, or by relative axial action of the stump in the socket and, as here shown, the passage 41 is shown as communicating with an axial bore 57 in the pivot 17 between the upper end of the piston rod and bifurcations of the upper support 5, a passage 58 communicating with the passage 57 and also with an axial bore 59 in the transverse pin 590 to which a pipe 60 is coupled leading to the control member. Thus when pressure is applied to the fluid in the passage 41 during the walking cycle, the plunger head and the valve move a distance commensurate with the amount of movement of the control member by the tensioning action. The supply pipe 60 is interchangeably connectable to the passage 59 either through the port 61 or directly to the passage 59. The connection for the pipe 60 not used is closed by a cap 62.

It is apparent that all parts of the knee lock mechanism can be applied to conventional legs

5

for above-the-knee amputees and used with the type of control best suited to the amputee, and the standard parts can be supplied to the manufacturer of the legs, he making the selection for the individual requirements of the various amputees. For instance, all the parts including the upper support 5, the lower support 11, 12, frame members 10, knee lock cylinder and piston 13, 14, foot operated link 51 and shock absorbing dash-pot 46, 47, Figure 1, with any selected type of control might be required for legs for one class of amputee, while only the supports 11 with only the knee lock cylinder and piston, Figure 3, may be required for another class of amputee, and also when all parts are necessary the adjustment of the knee lock cylinder may be coordinated through the lever 12, Figure 1, or not coordinated, Figure 7.

What I claim is:

1. A self contained knee lock mechanism for artificial legs which comprises a stump receiving socket and a foot unit in which the foot is pivoted to the lower leg by an ankle joint, said mechanism comprising an upper support attachable to the lower end of the socket, a lower support comprising a bracket element attachable to the lower leg unit intermediate of the ends thereof, and a lever element pivoted to the bracket element, a frame link pivoted at its upper end to the upper support by a knee joint and at its lower end to the bracket element of the lower support, a hydraulic knee lock link pivoted at its upper end to the upper support eccentric to the knee joint, and at its lower end to one of the elements of the lower support, the hydraulic link comprising a throttle valve operable to different positions during the walking cycle, a motion retarding device connected between the upper support and the lever element of the lower support, and a link connecting the foot eccentric to the ankle joint and the lever element of the lower support.

2. A self contained knee lock mechanism for artificial legs which comprises a stump socket

6

and a lower leg and foot unit in which the foot is pivoted to the lower leg by an ankle joint, said mechanism comprising supports attachable to the lower end of the stump socket and to the body of the lower leg, a frame member hinged by the knee joint to the upper supporting member and fixedly attached at its lower end to the lower supporting member, a hydraulic link pivoted at its upper end to the upper supporting member by a joint spaced radially from the knee joint hinge and at its lower end to the lower support, the lower support comprising a bracket attachable to the lower leg and a lever fulcrumed to the bracket, the link including a cylinder element and a piston and rod element working in the cylinder element, one of the elements being formed with a by-pass between opposite ends of the cylinder, a normally fully-open throttle valve in the by-pass operable progressively toward closed position and in the other direction to open position by means operated during the walking cycle, the lower end of the hydraulic link being interchangeably pivotally mountable on the bracket and the lever, a motion retarding member connected to the lever and to the upper support, and a link connecting the foot eccentric to the ankle joint and to the lever.

JOHN G. CATRANIS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,305,291	Filippe	Dec. 15, 1942

FOREIGN PATENTS

Number	Country	Date
304,926	Germany	Apr. 15, 1918
498,934	France	Nov. 4, 1919
530,887	France	Oct. 12, 1921
430,623	France	Oct. 6, 1921