

Dec. 7, 1954

J. J. GALDIK

2,696,011

ARTIFICIAL LEG WITH SUCTION SOCKET

Filed June 1, 1951

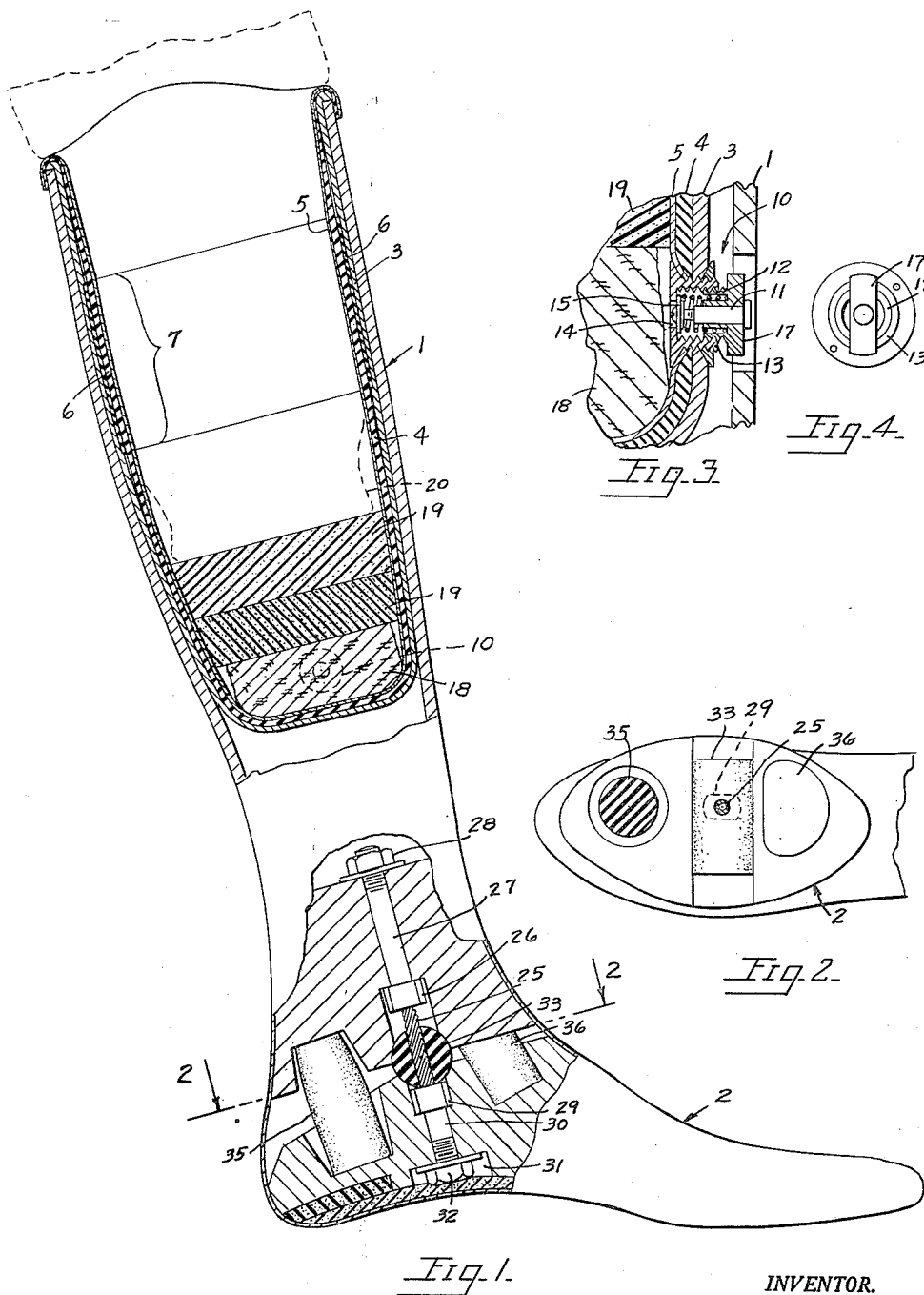


Fig. 3

Fig. 4

Fig. 2

Fig. 1

INVENTOR.
JOHN J. GALDIK

BY
Boyle, Mohler & Beckley

ATTORNEYS.

1

2,696,011

ARTIFICIAL LEG WITH SUCTION SOCKET

John J. Galdik, Larkspur, Calif.

Application June 1, 1951, Serial No. 229,480

2 Claims. (Cl. 3—17)

This invention relates to artificial limbs and particularly to an artificial leg for a suction type socket for an amputation that is below the knee.

Amputations that are above the knee do not present the same problems to the artificial limb maker that are presented where the amputations are between the ankle and the knee. In the former instance suction type sockets in artificial legs have been employed with a certain degree of success, but heretofore, no such success has attended efforts to produce a satisfactory suction socket arrangement for amputations of the last mentioned type. The reasons for this have mainly been (1) the impossibility of getting a proper seating of the stump by use of the conventional method of drawing the stump into the socket with assistance of a silk stocking (2) the failure to provide a suction socket and method of fitting the same to the stump that would avoid edema, and (3) an artificial limb that would be adequately safe and secure under practically all conditions of use.

One of the objects of the present invention is the provision of an artificial leg that will overcome the above obstacles.

A still further object of the invention is the provision of an improved method of securing an artificial leg to a below-the-knee amputation.

An added object is the provision of an artificial leg that enables the wearer to obtain better action in walking and in using the leg than heretofore and in which leg the parts that are movably joined are not susceptible to breakage and to detrimental wear at the joint as has heretofore been the case.

Another object is the provision of an artificial leg adapted to be secured to the stump of a below-the-knee amputation, and which leg is more comfortable than heretofore and is provided with an ankle structure that contributes to the safe securing of the leg to the stump when the leg is being used.

Other objects and advantages will be seen from the description and in the drawings.

In the drawings,

Fig. 1 is a part sectional and part elevational view of an artificial leg showing the socket and ankle structure in cross section.

Fig. 2 is a sectional view taken along the line 2—2 of Fig. 1.

Fig. 3 is an enlarged sectional view of the valve that is in the lower end of the socket.

Fig. 4 is an elevational view of the valve of Fig. 3, separate from the leg as seen from the side that is adapted to face outwardly when it is secured to the leg.

In detail the leg illustrated comprises a foot portion 2. Secured within the body 1 is an upwardly opening socket or "bucket" 3 having a layer 4 of relatively soft rubber or similar material secured therein and a lining 5 of any suitable grease and perspiration resistant material, such as one of the synthetic plastic materials.

Spaced below the upper open end of the socket 3 an added layer 6 of rubber or the like is provided between the layer 4 and the socket so that the diameter of the socket in the zone indicated at 7 (Fig. 1) is slightly less than the diameter above and below said zone.

The structure as above described is preferably employed where the socket has been made from a cast of the stump. In such instances the socket is made separate from the body 1 and is then secured within the body 1.

Where the body 1 itself has been carved out or formed

2

to provide the socket for the stump, and has been carefully fitted by the leg maker to the stump, the reduced diameter portion is formed in the body itself, thus eliminating the necessity for using the extra layer 6.

Hereinafter, in referring to the "socket" it is to be understood that this refers to the finished socket portion of the leg including the lining irrespective of whether the socket is made in the body itself or is separately made and later inserted.

It is customary in making an artificial leg for a below-the-knee amputation, to position the socket for the stump so that it is substantially coaxial with a vertically extending line slightly offset toward the inside of the leg from a line extending between the center of the knee and ankle.

In the present instance the degree of such offset is preferably slightly greater than heretofore. The reason for this is that, in the average man, the leg tends to throw or move laterally outwardly when it receives the weight in walking. In a socket type artificial leg this tendency seems to be more noticeable to the user, and by offsetting the socket as above described, this tendency is neutralized and is eliminated and the user feels safer, even though there may be no particular danger of the leg actually being loosened.

The lower end of the socket is formed with a relatively small opening in which is secured a check valve 10. Said valve preferably is provided with a stem 11 reciprocally extending through an adjusting screw 12 that in turn is threaded into the valve body 13. The body 13 is provided with a central aperture 14 closed by sealing disc 15 on stem 11, and a spring reacts between the disc 15 and the screw 12 for yieldably holding the disc in a position closing aperture 15 against admission of air into the lower end of the socket through the valve, but permitting the air to pass out of the socket. The head 17 (Fig. 4) of the screw 12 is relatively narrow to permit escape of air therepast. No claim is made to this valve in itself, but it is pertinent to note that it is relatively small, and that it would be impossible to pull a silk stocking through it after the screw 12 and parts associated therewith were removed. In conventional artificial legs, the valve is so large that the stocking used to draw the stump of the leg into the socket may be drawn through the valve opening, during the action of seating the stocking covered stump of the leg in the socket, so that the stocking is drawn from the stump and is removed from the artificial leg as soon as the stump is seated in the socket.

Within the lower end of the socket is a block 18 of light weight relatively solid material, such as cork, and it is preferably so shaped as to permit air in the socket to readily reach the valve at all times. This block extends over the valve to protect the latter as well as to prevent anything from interfering with the operation of the latter.

Supported on block 18 is one or more pads 19 of soft, resilient material such as foam rubber or plastic. The lower end of the stump 20, indicated in dash lines in Fig. 1, rests on the top pad 19, where more than one is used, or if only one is used then it engages the upper side of the latter.

The reason for using separate pads 19 and block 18, is to enable providing exactly the correct pressure, and correct type of pressure, on the lower end of the stump. Unless these two requirements are met, together with a proper sealing of the stump with the zone 7 in the socket, oedema will develop.

In a below the knee amputation, a certain amount of flesh is usually developed below the lower end of the leg bone. If there is no support for this flesh from below, it will be drawn downwardly by gravity and when a seal is created at zone 7 together with a partial vacuum in the lower end of the socket at every slight upward movement of the stump in the socket, the blood will not circulate in the lower end of the stump. Edema is the result of such lack of circulation.

By providing a soft pad 19 to press upwardly on the flesh at the lower end of the stump at all times, but with insufficient force to tend to force the stump out of the socket, a massaging action will occur during walking and use of the leg in normal activities that will

stimulate sufficient circulation of blood to prevent oedema from developing.

Some users can stand more end pressure on the stump than others, hence, the block 18 can be increased in thickness (vertically) and the thickness of the pad section 19 can be reduced. Practically any degree of pressure is obtainable by varying the thickness of the pad section 19 relative to the block section 18.

In putting on the leg, the person first coats the stump with a lubricant, such as cold cream or a material that will not be detrimental to the lining 6 nor to the skin. The stump is then inserted into the socket, and resistance to such insertion is encountered at reduced diameter zone 7, just before the final seating of the leg. The weight of the body is taken at the upper edge of the socket, and not at the zone 7. The latter is merely a sealing zone and it must be spaced below the upper edge of the socket and above the lower end of the stump to be satisfactory and comfortable.

There is practically no up and down movement of the stump in the socket, other than is permitted by skin movement relative to the bone, and at all times the end pressure on the lower end of the stump is maintained to some degree, but to so small an extent that it will not tend to force the leg out of the socket. Usually just enough to counteract the force of gravity on the flesh at the lower end of the stump enough. The massaging action then occurs without any painful or noticeable pressure on the lower end of the stump.

It may be here pointed out that the use of the lubricant is necessary to enable the stump to make an air seal at zone 7 and once this seal is made, the lubricant may disappear, but without breaking the seal. In other words, once the stump is sealed the presence or absence of the lubricant is of no moment. The desired seal cannot be obtained by the conventional method of using a silk stocking.

The foot portion 2 is secured to the body 1 of the leg by means of a flexible cable 25. Said foot portion is separate from the body 1 along a plane of division that extends through the ankle, and the lower surface of the body 1 is along line 2-2 of Fig. 1.

The cable 25 is rigidly secured at its upper end to the flat sided end 26 of a bolt 27 that extends axially into the body of the leg with a nut 28 at the upper end of the bolt in the lower end of the socket within which the stump socket 3 is secured.

The lower end of cable 25 is secured to the flat sided upper end 29 of a bolt 30 that extends through the foot portion into a downwardly opening recess 31 on the sole of the foot. A nut 32 on the lower end of the bolt 30 reacts against the base of recess 31.

Said cable 25 extends through an opening in a cylindrical resilient block of material 33, such as of rubber and this block extends horizontally across the foot portion as seen in Fig. 2, and is seated in complementarily formed recesses in the opposed sides of the foot and body portions of the leg.

The degree to which the cable 25 is tightened determines the degree of flexibility of the ankle, since block 33 spaces the foot and body portions at all times thus permitting universal tilting movement of the foot portion relative to the body, which is highly desirable in that the strain of any force from the socket tending to swing the leg to any side is not against a rigid stop, but is taken by the yieldable joint.

Furthermore, the cable strands will not separate nor untwist by reason of the flexing thereof. The heads 26, 29 prevent any relative rotation between the ends of the cable.

Rearwardly of the block 33 is a resilient rubber block 35 that extends at its ends into recesses formed in the body and foot portion and forwardly of the block 33 is a third block of rubber 36 that is supported in a recess in the foot portion and that engages the lower end of the body of the leg.

The generally opposed sides of the body and foot portions of the leg extend divergently relative to each other from the block 33 and the opposed surfaces of the said foot and leg portions are spaced apart forwardly of 80

block 33. The block 35 is softer or more easily compressed than block 36 because it merely functions to restore the toe end of the foot to the position indicated in Fig. 1 after the block 36 has been compressed by the normal application of force applied to said toe portion in taking a step.

The desired tension may be given to cable 25 before the lower side of the foot is covered by the conventional rubber and leather layers, and access to nut 32 for further adjustment is not difficult, since the said layers can easily be removed and replaced.

It is seen that the provision of the unusual ankle joint as above described will contribute to the comfort of a suction socket inasmuch as in a suction socket there is no harness or mechanical attachments for securing it to a stump. The suction is all that holds the stump to the artificial leg.

The weight of the person using the leg is taken principally by the central rubber bearing 25.

It is to be understood that the cork in Fig. 1 may be replaced by a coil spring provided the end pressure on the stump is controlled, or other material may be used. The important feature is that the soft pad that engages the end of the stump is above the valve so that no chafing can occur between the stump and the valve. Also the means for providing such end pressure should not take any noticeable portion of the weight of the person. It merely maintains a pressure on the stump that counteracts gravity on the flesh at the end of the stump and the effect of the reduced pressure resulting from the creation of a partial vacuum. The exact reason why the present invention overcomes oedema is not fully known, but the fact that it occurs where no end pressure is provided in a suction socket has been established beyond doubt by the present invention which provides such pressure as hereindescribed, and which overcomes this ailment.

I claim:

1. In an artificial leg for a below-the-knee amputation, a suction socket formed in said leg for receiving the stump of the amputated leg, a check valve in a wall of said socket adjacent to its lower end adapted to open to exhaust air from within said socket to the atmosphere and to close to prevent ingress of air, a pad of soft, resilient material in the lower end portion of said socket, means for supporting said pad at a level above said valve for engagement between said pad and the outer end of said stump when the latter is fitted within said socket, the walls of said socket being formed to provide an air tight seal with said stump at a point spaced below the upper edges of the walls of said socket.

2. In an artificial leg for a below the knee amputation, a suction socket formed in said leg for receiving the stump of the amputated leg, a check valve in a wall of said socket adjacent to its lower end adapted to open to exhaust air from within said socket to the atmosphere and to close against admission of air therethrough into said socket, the walls of said socket including a lining and a band of resilient material between said lining and the surface of the socket adjacent thereto at a level spaced below the upper edges of said walls and relatively close to said edges with respect to the closed lower end of said socket providing a restriction in the diameter of the socket at the level of said band to form a hermetic seal with said stump at said level, a resilient pad, means supported on the bottom of said socket and extending upwardly past said valve for supporting said pad in constant but relatively light engagement with said stump.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
578,222	Donaldson et al.	Mar. 2, 1897
980,457	Toles	Jan. 3, 1911
2,066,599	Willett	Jan. 5, 1937

FOREIGN PATENTS

Number	Country	Date
501,053	France	June 25, 1919