

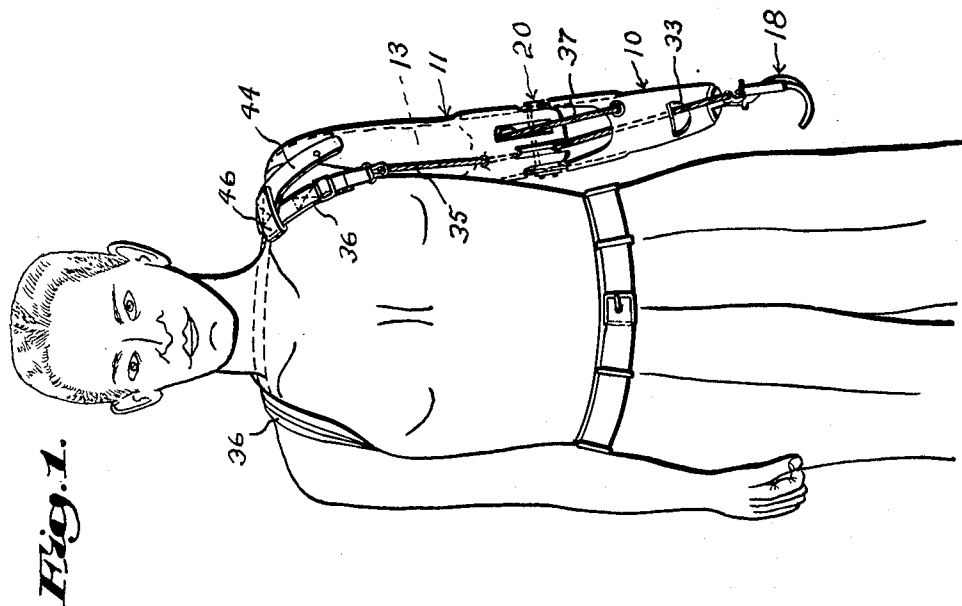
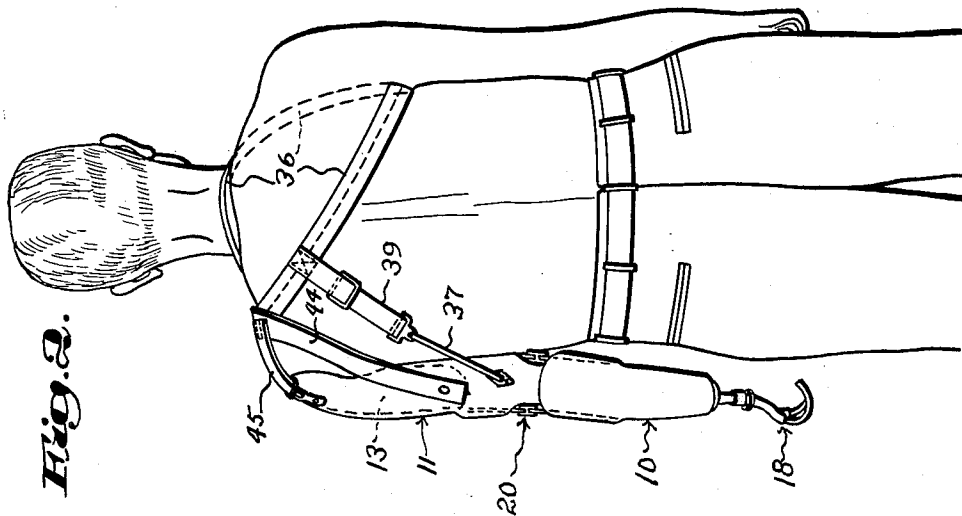
May 13, 1958

J. C. AVENI
ARTIFICIAL ARM

2,834,024

Original Filed Jan. 27, 1951

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Fig. 3.

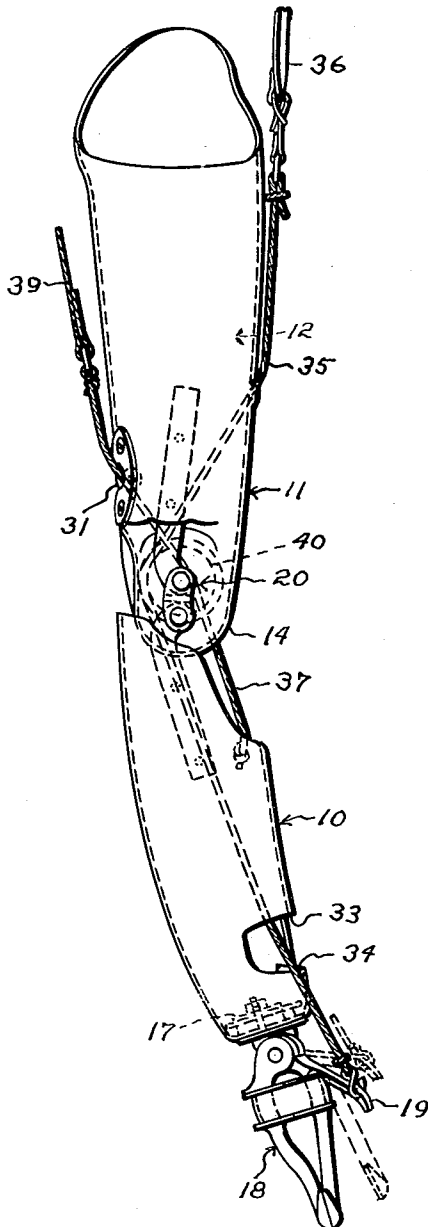
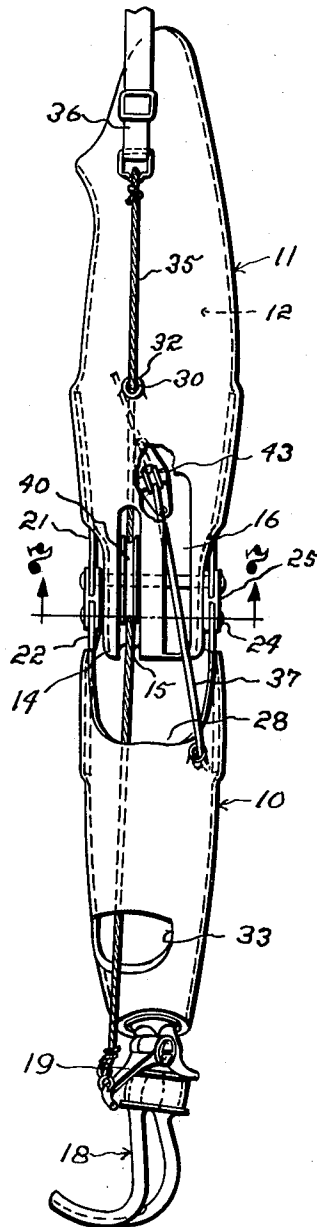


Fig. 4.



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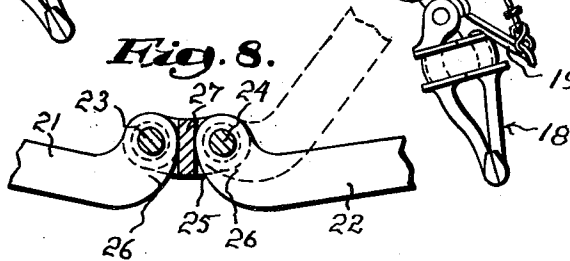
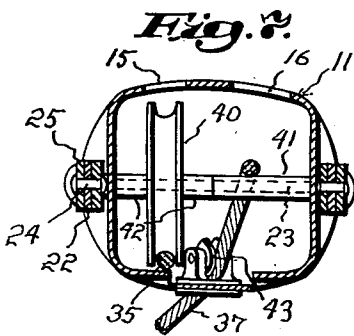
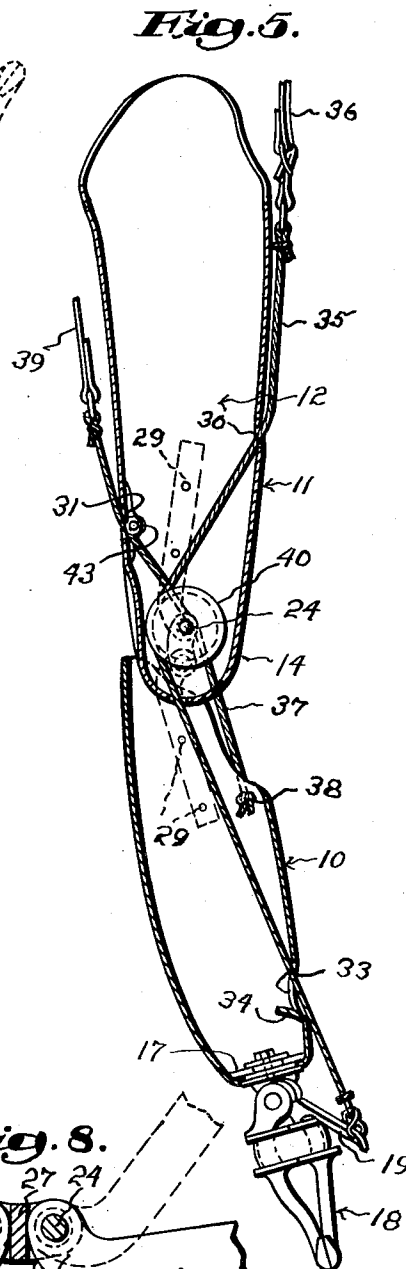
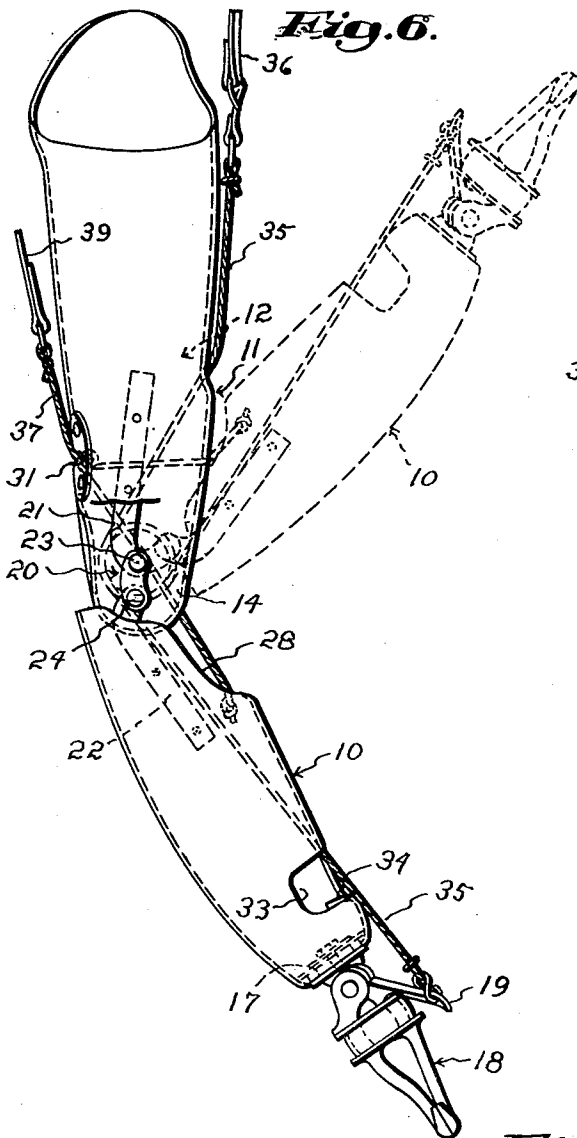
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2,834,024

ARTIFICIAL ARM

Joseph C. Aveni, Melrose, Mass.

Continuation of application Serial No. 208,199, January 27, 1951. This application September 10, 1954, Serial No. 455,162

2 Claims. (Cl. 3—12)

This invention relates to jointed artificial arms and particularly to control means therefor to enable either the gripping device or the arm flexing to be operated by the wearer independently of or in conjunction with the other and regardless of whether such other has been operated and which are adaptable both to individual requirements and general requirements of lightness in weight, strength, and ease of operation. The present application is a continuation of my copending application, Serial No. 208,199, filed January 27, 1951, and now abandoned.

It is widely appreciated that a person who has lost a limb is capable of effectively overcoming his handicap by prosthesis. Whether that objective is attained is dependent on several factors. An artificial arm, for example, includes an upper arm section, a forearm section, and a suitable connection between those sections enabling the arm to be suitably bent and straightened. An artificial hand or other gripping device is attached to the free end of the forearm section while the upper end of the upper arm section is attached by harness to the wearer's body and is provided with a stump receiving socket. Various means have been employed to enable the arm to be flexed and the gripping device to be actuated by movement of either or both shoulders.

It is self evident that an artificial arm must combine strength, lightness in weight, and ease of operation to enable the wearer to really overcome his handicap and artificial arms that have been proposed have not adequately met those general requirements.

An underlying cause of inadequacy is the failure to recognize that each arm loss presents individual problems and these are well exemplified by variations in stump length. While the socket of each upper arm section must be shaped for the stump which it is to fit, it must be kept in mind that the utility of the stump in artificial arm manipulation, the nature of the attaching harness, and extent of motion that the wearer can effect depend on the length and strength of the stump. Such factors make essential that the arm flexing and gripping device operating means be adapted to limitations imposed by the nature of the injury and at the same time lend themselves to meeting the more readily appreciated requirements to which I have referred.

In addition, it will be understood that in order for the wearer to be able to use his artificial arm with real effectiveness, the control of arm flexing and the control of gripping device operation must, at all times, be capable both of separate actuation or of actuation in conjunction with each other. A common objection to existing artificial arms is that the gripping device is actuated when the arm is flexed and that the arm is flexed when the gripping device is operated unless an elbow lock is employed.

An arm in accordance with the invention thus meets the principal objective that a pull on the device actuating cord is inoperative to flex the arm while a pull on the other cord is only effective to flex the arm. Both cords

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may be actuated together and either may be actuated independently of the other so that the arm may be flexed or straightened whether or not the gripping device is actuated and the gripping device may be controlled as desired whether the arm is flexed or straightened.

At the same time, the invention is readily adaptable to meet individual requirements such as are imposed by the stump and makes possible artificial arms that are of simple construction and combine adequate strength, lightness in weight, and maximum ease of operation.

In the accompanying drawings, there is shown an illustrative embodiment of the invention from which these and other of its novel features and advantages will be readily appreciated.

In the drawings:

Fig. 1 is a view of an artificial arm, in accordance with the invention, showing it harnessed to a wearer, as seen from the front.

Fig. 2 is a corresponding rear view.

Fig. 3 is a view, on an enlarged scale, showing the arm as seen from the side that is disposed towards the wearer's body and illustrating the operation of the gripping device.

Fig. 4 is a view, on the same scale, of the arm as viewed from the front.

Fig. 5 is a view similar to Fig. 3 but showing the parts in section.

Fig. 6 is a view, also similar to Fig. 3, but illustrating the flexing of the arm.

Fig. 7 is a section along the lines 7—7 of Fig. 4, and Fig. 8 is a fragmentary and partly sectioned view, on a further increased scale, showing a preferred form of means to interconnect the arm sections.

In the embodiment of the invention shown in the drawings, there is generally indicated the hollow fore and upper arm sections at 10 and 11, respectively. While the arm sections may be made from any suitable material that is light in weight and has sufficient strength, plastic impregnated glass cloth has been found to possess both of these necessary characteristics to an extent making that material strongly preferred.

The upper end of the arm section 11 constitutes a socket generally indicated at 12 molded to fit the stump 13 of the wearer's arm. Stumps vary, of course, as to size and shape and are a factor determining the details of artificial arm and attaching harness construction and also the extent of motion in the artificial arm that the wearer can effect. The other end 14 of the arm section 11 is preferably both tapered and rounded and formed with parallel slots 15 and 16 extending from front to back, as may be seen in Fig. 4.

The lower end of the fore arm section 10 has a support 17 detachably mounting a gripping device 18 which is partially rotatable relative to the forearm section 10. As the support 17 and the gripping device 18 are not a part of the invention, these are not detailed but reference is made to the lever 19 as illustrative of means by which such devices are operated. The upper end of the fore arm section 10 is shown as receiving freely within it the closed end 14 of the upper arm section 11 and these are connected by elbow simulating means, generally indicated at 20, enabling the arm to be flexed. The arm may be operated effectively with or without an elbow lock.

As it is important both that an artificial arm be capable of being flexed sufficiently to enable objects to be raised to the wearer's mouth and incapable of being bent rearwardly beyond a predetermined straightened position, it is preferred that the connecting means shown in the drawings and detailed in Figs. 7 and 8 be used.

There is shown, on each side of the arm, a forwardly extending member 21 attached to the upper arm section

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11 and a rearwardly extending arm 22 anchored to the fore arm section 10. The members 21 and 22, on each side, are pivotably connected as at 23 and 24, respectively, to a link 25 which is slotted at each end to receive the L-shaped portions 26 of each member and to provide a partition or stop 27 engageable by the portions 26 to prevent the arm from being straightened beyond a predetermined position while enabling the fore arm section 21 to swing on either or both pivots. The fore arm section 10 is shown as cut away as at 28 to further ensure that the arm may be sufficiently flexed. The members 21 and 22 are shown as bonded in place by the plastic with which the cloth is impregnated and for that reason are provided with holes 29.

Adjacent the lower end of the stump socket 12, the front portion of the arm section 11 is provided with an aperture 30 and the back portion thereof with an aperture 31, both of which may be provided with a metal eyelet 32. The front of the forearm section 10 is formed with a transverse slot 33 of a length equal to the travel of the lever 19 as the gripping device is turned from one extreme position of use to another. At the front edge of the slot 33, there is shown a lip 34 defining an anti-friction guide surface for the end of the cord 35 that is to be attached to the lever 19 of the gripping device. The cord 35 is housed by the arm sections and passes through the slot 15 and is exposed through the aperture 30 for attachment to the adjustable harness strap 36.

A second cord 37 is housed in the arm section 11. At its front end, the cord 37 is anchored as at 38 to the forearm section 10 and extends through the slot 16 and rearwardly through the aperture 31 where it is exposed for attachment to the adjustable harness strap 39.

In accordance with the invention, there is provided means in the arm locating the cord 35 on the side, opposite the aperture 30, of the pivot center of the connecting means 20 that is adjacent the lower end of the arm section 11 and the cord 37 on the side of that center that is opposite its aperture 31. This ensures that the cord 35 is disposed so that, whether the arm is flexed or straightened, a pull on it to operate the gripping device will not affect the position of the forearm section 10 and so that, whether or not the gripping device is operated, a pull on the cord 37 will flex the arm.

This objective may be attained in various ways but the means, for so doing, shown in the drawings is preferred. In practice, a single transverse member constitutes the pivot 23 between the links 25 and arms 21 on both sides of the arm. A pivot 23 is employed to rotatably support a pulley 40 within the arm section 11. The pulley 40 is located on the pivot 23 in alignment with the slot 15 by a spacing sleeve 41 which engages one of the hub ends 42 of the pulley 40. I effect the desired spacing of the cords in this embodiment of my invention, by training the cord 35 under the pulley 40 and by disposing the cord 37 over the sleeve 41. This structure ensures excellent anti-friction support for both cords.

In practice, it is preferred that a pulley 43 be mounted on the inner surface of the arm section 11 and adjacent the aperture 31 to ensure a minimum of frictional resistance to movement of the cord 37 which is trained under the pulley 43. The term "cord" is used herein to include any suitable flexible connecting strip but, in practice, nylon cord is preferred.

While the nature of the harness depends to a substantial extent on the requirements of each individual, a strap 44 is shown as connected to the arm section 11 adjacent its upper end at the front and back to straddle the shoulder with a strap 45 connected to the intermediate part of the strap 44 and the arm section 11. The strap 44 has a loop 46 to slidably receive the harness strap 36 which, as may be seen in Figs. 1 and 2, extends across the back of the wearer's neck and forwardly and downwardly around the other shoulder from which point it lies up-

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wardly across the back and is anchored to the strap 44. Adjacent its anchorage to the strap 44, the adjustable harness straps 36 and 39 are interconnected. The harness shown in the drawings forms no part of this invention, but is preferred because of its simplicity and because it well illustrates the use of artificial arms in accordance with the invention.

Both in flexing of the arm and the opening and closing of the gripping device, shoulder movements are employed to loosen and tighten the harness to exert pulls on the cords or to loosen them. It will be appreciated that a pull on the cord 35 is effective to open the gripping device while a pull on the cord 37 causes the fore arm section 10 to swing upwardly.

As both cords are housed within the arm sections in the zone where clothing might interfere with their movement and both are trained over and supported in proper position by anti-friction members, it will be appreciated that they may be actuated with a minimum of resistance. It will thus be appreciated that artificial arms in accordance with the invention are well adapted to meet the general requirements of strength, lightness in weight, and ease of operation. The invention also makes possible the adaptation of arms made in accordance therewith to individual requirements as the cords may pass outwardly through the upper arm section adjacent the bottom of the stump socket regardless of the length of the stump without any change in the elbow simulating connection.

It will be apparent, however, that the length of the stump makes necessary certain changes as in practice it is necessary to locate the apertures 30 and 31 as close as possible to the bottom of the stump socket 12. With a stump longer than that indicated in the drawings, the apertures 30 and 31 would be located correspondingly nearer the pivot center established by the pivot 23 and, in such instances, the diameter of the pulley 40 is decreased.

Attention is directed to the slots 15 and 16 in the lower end 14 of the upper arm section. As will be apparent from Fig. 6, these slots accommodate the cords 35 and 37 when the arm is flexed and are utilized to minimize the amount of stock that is removed from the end 14. As will be apparent from Fig. 4, the slot 16 is shown as considerably wider than the slot 15. The reason for this is that it is desirable to have the cord 37 extend as straight as possible from its point of attachment to the harness strap 36 to the fore arm section 10. While its disposition is dependent on individual requirements, the cord 37 usually extends diagonally relative to the pivot axis, see Figs. 2 and 4, and is secured to the fore arm section 10 somewhat on the outside of its front portion and necessitates a relatively wide slot to prevent binding during arm flexing.

What I therefore claim and desire to secure by Letters Patent is:

1. An artificial arm for use with a gripping device and with a supporting harness, said arm comprising a hollow upper arm section having a stump receiving socket at its upper end, a hollow forearm section including at one end a device receiving support, means pivotally connecting the other ends of said arm sections so that said arm may be flexed from a predetermined straightened position with a pivot center at the lower end of said upper arm section, the front portion of said forearm section having an opening extending forwardly from its connected end and being dimensioned and located to enable said arm to be flexed to an extent approximately equal to that of a normal human arm, and a relatively wide transversely disposed slot adjacent said support in the front part of the side of said forearm section, said upper arm section having a first aperture in its front portion and a second aperture in its back portion located between the bottom of said socket and said center, an arm flexing cord attached at one end to the front

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portion of said forearm section adjacent the front end of said opening and extending freely into said upper arm section and directly through said second aperture for attachment to said harness, said means including a pulley and a transverse supporting shaft mounted in the lower end of said upper arm section over which shaft said cord extends, and a second cord in said arm trained under said pulley with one end extending directly through said slot for attachment to said device and the other end extending directly through said first aperture for attachment to said harness.

2. An artificial arm for use with a gripping device and with a supporting harness, said arm comprising a hollow upper arm section having a stump receiving socket at its upper end, a hollow forearm section including at one end a device receiving support, means pivotally connecting the other ends of said arm sections so that said arm may be flexed from a predetermined straightened position, the front portion of said forearm section having an opening extending forwardly from its connected end

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and being dimensioned and located to enable said arm to be flexed to an extent approximately equal to that of a normal human arm, and a relatively wide, transversely disposed slot adjacent said support in the front part of the side of said forearm section, said upper arm section having an aperture in its front portion located between the bottom of said socket and said center, said means including a rotatable member mounted in the lower end of said upper arm section and a device operating cord in said arm trained around said rotatable means with one end extending directly through said slot for attachment to said device and its other end extending directly through said aperture for attachment to said harness.

References Cited in the file of this patent

UNITED STATES PATENTS

46,159	Uren	Jan. 31, 1865
760,102	Carnes	May 17, 1904
1,046,967	Carnes	Dec. 10, 1912