D. M. ANDERSON.

ARTIFICIAL HAND.

APPLICATION FILED JULY 14, 1920.

1,377,956.

Patented May 10, 1921.

2 SHEETS—SHEET 1.

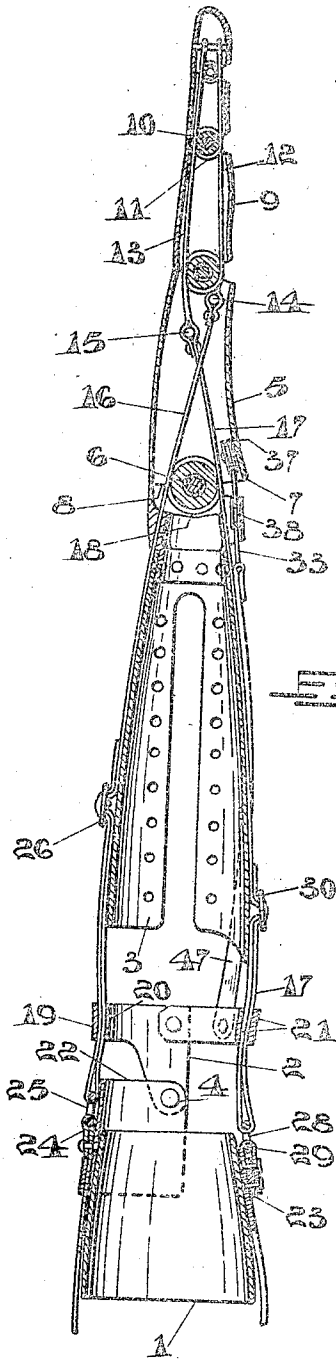


Fig. 1.

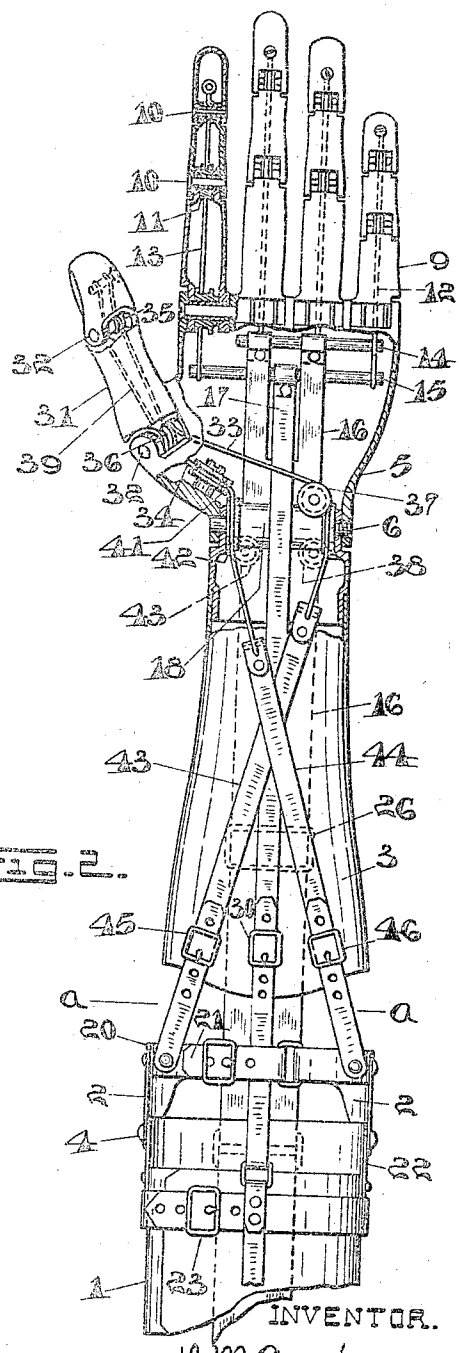


Fig. 2.

INVENTOR.

W. M. Anderson.

BY J. Edward Maybee.

ATTY.

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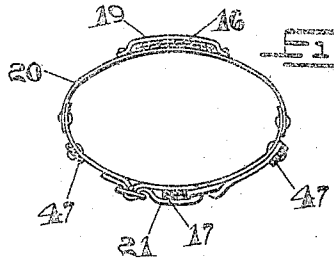


Fig. 4.

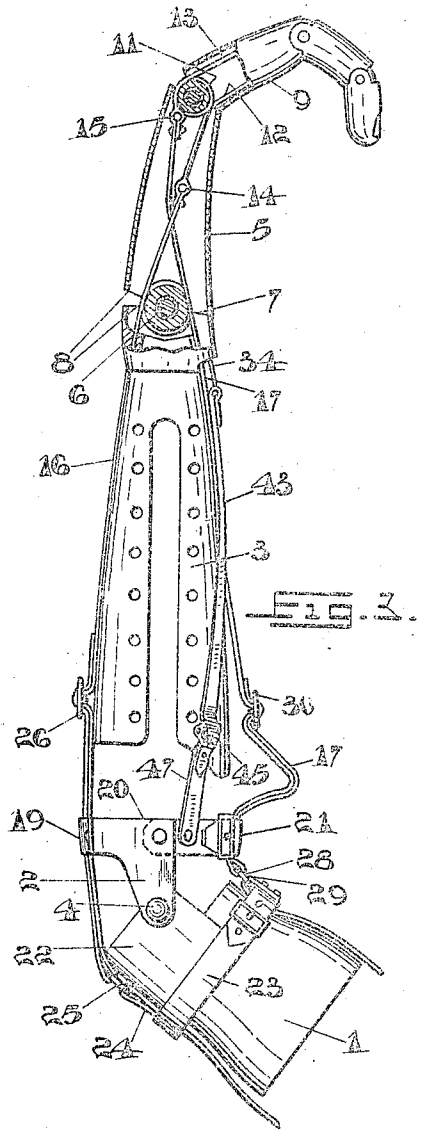


Fig. 3.

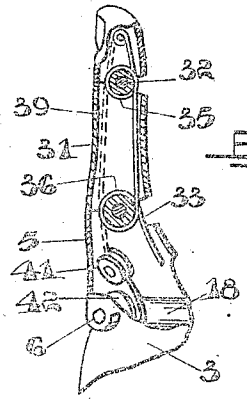


Fig. 5.

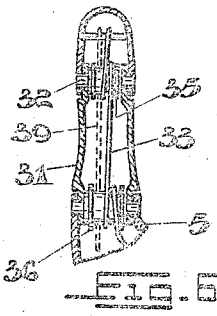


Fig. 6.

INVENTOR.

W. M. Anderson.

BY J. Edward Maybee.

ATTY.

UNITED STATES PATENT OFFICE.

DUNCAN MACKENZIE ANDERSON, OF TORONTO, ONTARIO, CANADA.

ARTIFICIAL HAND.

1,377,956. Specification of Letters Patent. Patented May 10, 1921.

Application filed July 14, 1920. Serial No. 396,045.

To all whom it may concern:

Be it known that I, DUNCAN M. ANDERSON, of the city of Toronto, in the county of York, Province of Ontario, Canada, a subject of the King of Great Britain, have invented certain new and useful Improvements in Artificial Hands, of which the following is a specification.

This invention relates to hands particularly adapted for use by patients who possess a fore-arm stump, and my object is to devise a hand resembling as closely as possible the natural hand and in which the fingers and thumb may be flexed and extended by natural movements of the fore-arm stump.

I attain my object by means of the constructions hereinafter described and illustrated in the accompanying drawings in which—

Figure 1 is a longitudinal section of my improved hand and the parts requisite for supporting and operating the same;

Fig. 2 a front elevation of the same parts partly in section;

Fig. 3 a side elevation of the same parts, partly in section and showing the fingers flexed;

Fig. 4 a section on the line *a*—*a* in Fig. 2;

Fig. 5 a side elevation, partly in section, of the thumb member; and

Fig. 6 a front elevation, partly in section, of the thumb member.

In the drawings like numerals of reference indicate corresponding parts in the different figures.

1 is an upper arm sheath, which may be of any ordinary construction and is provided with suitable means for securing it about the upper arm member. Any ordinary harness may be used to hold the sheath in place. 3 is a forearm bucket adapted to receive the stump of the wearer's forearm. This bucket is hinged at 4 to the upper arm sheath, the hinge being in alinement with the wearer's elbow joint. This hinge it will be seen is formed between lugs 2 on the band 20 and the band 22 of the upper arm sheath. The band 20 is, however, only connected with the forearm bucket by the straps hereinafter referred to.

To the forearm bucket the hand 5 is connected. Preferably the connection is by means of a hinge pin 6, so that the hand may flex as on the natural wrist joint. The movement is limited in either direction by the shoulders 7 and 8 formed on the forearm bucket and the hand. The hand is provided with jointed fingers 9, the joints being formed in any suitable manner.

On the hinge pins 10 of the finger joints are rotatably mounted the grooved rollers 11 for the guidance of finger flexing and extending cables 12 and 13, which pass over or around said rollers. It will be understood that by the term "cable" I intend to imply any wire, cord, chain or the like adapted to perform the function of flexing or extending the fingers when tension is applied thereto. The cables 12 and 13 are preferably connected to the cross bars 14 and 15 to which are connected the finger flexing and extending straps 16 and 17. It will be understood that while for convenience I use the term "strap" any suitable flexible substitute may be employed instead of the strap without departing from my invention.

The flexing strap 16 extends from the cross bar 14, passes behind a suitable guide to the back of the forearm bucket, extends longitudinally of the same and is connected to the back of the upper arm sheath 1. The guide at the wrist around which the strap passes is preferably formed as a roller 18 journaled on the hinge pin 6. The flexing strap at the elbow preferably passes through a guide 19 formed on the band 20 forming part of the forearm bucket adjacent the elbow joint and provided with the adjusting strap and buckle 21. The lower end of the upper arm sheath is formed with a band 22 provided with an adjusting strap and buckle 23 and to this band 22 is secured a loop 24, to which loop the strap 16 is connected by a link 25, the strap passing around the link and having its end secured to the main part of the strap by an adjusting buckle 26 whereby the strap may be adjusted in length as may be necessary.

From the construction described, it follows that the bending of the forearm bucket on the upper arm sheath at the elbow joint will tension the strap 16 and cause the hand and fingers to be flexed as shown in Fig. 3. The finger-extending strap 17 is connected to the cross bar 15 and passes over the front of the roller 18, thence running longitudinally of the forearm bucket through a guide formed by the strap 21, thence passing around a link 28 connected with a loop 29 secured to the strap 23 of the upper arm sheath.

The end of the strap 17 is provided with the adjusting buckle 30, whereby the length of the strap may be adjusted as may be necessary. From this construction it follows that the straightening of the forearm bucket relative to the upper arm sheath will extend the fingers as shown in Figs. 1 and 2 of the drawings. As the straps 16 and 17 must cross one another in the hand, I make one of them of greater width than the other as shown particularly in Fig. 2 and form a slot or opening in the one for the passage of the other.

The arrangement whereby the cross bars 14 and 15 form the connection between the cables 12 and 13 and the straps 16 and 17 is important, as a rocking movement of the bars permits the fingers to be flexed to a different extent to better adapt them to the clasping of objects varying in diameter at different parts of their length. The thumb member 31 is jointed, the joints being formed by the hinge pins 32.

Thumb flexing and extending cables 33 and 34 are provided passing over or around a guide pulley 35. The flexing cable 33 is secured within the end joint of the thumb and passes entirely around the guide pulley 35 journaled on the hinge pin of the end joint of the thumb, thence passes to and completely around the guide pulley 36 journaled on the hinge pin 32 of the first joint of the thumb, thence the cable passes around the guide pulleys 37—38 journaled respectively on the band and the lower end of the forearm bucket. It is evident that by tensioning this cable that the thumb will be flexed. The hinges of the joint of the thumb are, of course, so arranged as to give the thumb proper movement transversely of the hand. The extending cable 39 is connected to the outer joint of the thumb and passes behind the guide pulley 35, and also behind the guide pulley 36 on the hinge pin of the inner joint of the thumb, thence passing around a guide pulley 41 journaled in the hand, around a guide pulley 42 which in effect may be one end of the roller 18, and around the guide pulley 43 in the lower end of the forearm bucket. The guide pulleys are, of course, suitably positioned to give the proper direction to the cable. By tensioning the thumb extending cable 39, it is evident that the thumb will be extended. The necessary tension to these cables is applied as desired by mechanism operated by a turning movement of the forearm bucket relative to the axis of the upper arm, which movement is effected by the stump of the wearer's forearm. An outward turning movement, it will be noted, extends the thumb and an inward turning movement flexes it.

The operating devices comprise the two straps 43 and 44, which extend longitudinally and diagonally of the front of the forearm bucket and are adjustably secured by means of buckles 45 and 46 to the loops 47 secured to the band 20. As the band 20 cannot turn with the lower part of the forearm bucket, the turning movement of the forearm causes the tensioning of one strap and the relaxing of the other, and thus the movements of the thumb are effected as desired.

I find that by means of the constructions described I provide a hand which will satisfactorily attain the objects of my invention as set out in the preamble to this specification. It will be evident, however, that various changes in the details of construction may be made without departing from the spirit of my invention. For example, springs may be employed to either flex or extend the thumb and fingers, the strap being used to produce the opposite movement. It is also preferable to introduce a certain amount of resiliency into the cables or straps to take up any lost motion or to give elasticity to the grip of the thumb or fingers. For example, parts of the straps may be made of heavy rubber or elastic webbing.

What I claim as my invention is:—

1. The combination of an upper arm sheath; a fore-arm bucket; a hand connected to the end of said bucket and provided with jointed fingers; finger-flexing and finger-extending cables suitably guided in the fingers; a finger-flexing strap connected to the finger-flexing cables, extending along the back of the forearm bucket and connected to the upper arm sheath; and a finger-extending strap connected to the finger-flexing cables, extending along the front of the fore-arm bucket and connected to the upper arm sheath.

2. An artificial limb constructed as set forth in claim 1 provided with a hinge joint between the hand and forearm bucket and a guide at the joint on opposite sides of which the straps pass to their points of connection with the finger operating cables.

3. The combination of an upper arm sheath; a fore-arm bucket; a hand connected to the end of said bucket and provided with a jointed thumb; a flexible thumb operating connection suitably guided and extending lengthwise and diagonally of the forearm bucket and connected to the upper arm sheath so as to be tensioned by a turning movement of the forearm bucket.

4. The combination of an upper arm sheath; a forearm bucket; a hand connected to the end of said bucket and provided with a jointed thumb; a flexible thumb flexing connection suitably guided and extending lengthwise and diagonally of the forearm bucket and connected thereto; a flexible thumb-extending connection suitably guided and extending lengthwise and

diagonally of the forearm bucket crosswise of said first mentioned flexible connection and connected to the bucket, whereby a turning movement of the forearm bucket in one direction tensions one flexible connection and a turning movement in the opposite direction the other flexible connection.

5. An artificial limb constructed as set forth in claim 1 provided with cross bars to which said straps are connected substantially midway between their ends, the cables being also connected thereto in substantial alinement with the fingers.

6. The combination of an upper arm sheath; a forearm bucket: a hand connected to the end of the bucket and provided with jointed fingers; finger-bending cables suitably guided in the fingers; a finger bending strap connected to the finger bending cables extending longitudinally of the forearm bucket and connected to the upper arm sheath and adapted when tensioned to actuate the cables to bend the fingers; and means for effecting the reverse movement of the fingers; said strap and said means being arranged so that the bending of the forearm bucket on the sheath flexes the fingers and the extension of the forearm extends the fingers.

7. The combination of an upper arm sheath; a forearm bucket; a hand connected to the end of the bucket and provided with jointed thumb and fingers; finger bending cables suitably guided in the fingers; a finger bending strap connected to the finger bending cables extending longitudinally of the forearm bucket and connected to the upper arm sheath and adapted when tensioned to actuate the cables to bend the fingers; means for effecting the reverse movement of the fingers; a flexible thumb operating connection suitably guided and extending lengthwise and diagonally of the forearm bucket and connected thereto; and means for effecting the reverse movement of the thumb.

Signed at Toronto, Canada, this 22nd day of June, 1920.

DUNCAN MACKENZIE ANDERSON.