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ARTIFICIAL HAND

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12 Claims. (Cl. 3—12)

My invention relates to an improvement in artificial hands, wherein it is desired to provide a hand which will simulate the appearance and action of a human hand.

In my previous application, Serial No. 246,815, I described a hand construction which, in action, is somewhat similar to the present construction. In this former construction, the fingers were actuated by rigid links similar to those used in the present construction. Furthermore, in this former construction a rigid little finger was shown. Such a rigid little finger is also shown in the present case. Certain improvements have been made in my former construction, however, which are shown in the present case.

It is a feature of the present invention to provide an improved locking device to prevent the fingers from flexing into open position when they are subjected to strain. In my former application above referred to, I disclosed a ratchet having a series of spaced teeth designed to engage the lever used for operating the fingers. When the hand was engaging an object, and the fingers of the hand were closed upon the object, the locking lever would engage one or another of the teeth of the ratchet. From time to time, however, this locking lever would strike the portion of the ratchet between the teeth thereof. This would stop pivotal movement of the locking lever, and would prevent the fingers from closing upon the object grasped as would otherwise be the case. In such a case, it would be necessary either to retain an infirm hold upon the object, or else to pivot the locking lever away from the ratchet and then again grasp the object, attempting to cause the locking lever to engage one of the ratchet teeth.

It is an object of the present invention to provide a locking device which will lock under all conditions of operation. In place of a ratchet device, I now provide a locking arm beneath which the locking lever pivots. Accordingly, under all conditions of operation, the fingers will be locked to prevent spreading of the same accidentally.

It is a feature of my invention to provide a series of flexible and resilient fingers on the hand, as in my previous application, and to provide within these fingers a cushioning means to prevent distortion of the fingers. The fingers are preferably formed of coiled flat spring wire, and contain the operating links and operating rods necessary to flex the fingers. In between the coiled flat spring wire and the levers causing operation of the fingers I provide a soft re-

silient cushioning member such as felt, rubber or the like, to prevent the coils forming the fingers from flexing with respect to the operating links. Thus the coils forming the body of the fingers is held centered with respect to the operating links; and side pressure on the fingers will not cause the fingers to deform in an unnatural manner.

I have found that one of the objections to my previous type of hand constructions lies in the fact that the spiral springs forming the bodies of the fingers is exposed when the covering glove is removed. Persons who have recently suffered amputation of a hand are extremely sensitive of the fact; and the unnatural appearance of the coiled springs is found to be extremely distasteful. In order to conceal the springs while still retaining the advantages thereof, I coat the springs with a resilient material such as rubber, which forms a solid body which can be colored a flesh color. This feature is not only an important structural advantage, but also is of great benefit to the unfortunate persons whose hand or hands have been recently amputated.

It is a feature of my invention that the rubber covering on the spiral springs forming the fingers has numerous structural advantages. In the first place, the rubber encloses the springs and presents a smooth outward appearance. This not only forms a smooth foundation for the glove, but also prevents wearing of the glove due to contact with the spaced portions of the spring. In the second place, the rubber prevents the adjacent coils of the spring from rubbing together, making the hand operate more smoothly. In the third place, the mechanism within the coils is insulated from the coils by the rubber projecting through the coils and embedding the same, thereby making the hand operate noiselessly. The finger coverings also tend to keep moisture from reaching the operating mechanism of the hand.

These and other objects and novel features of my invention will be more clearly and fully set forth in the following specification and claims.

In the drawing forming a part of my specification:

Figure 1 is a perspective view of my hand, a portion of the hand body being broken away to disclose the operating mechanism thereof.

Figure 2 is a perspective view of the operating mechanism of the hand, showing the outline of the hand in dotted lines.

Figure 3 is a top plan view of the operating

mechanism of the hand, the hand body and finger bodies having been omitted.

Figure 4 is a side elevational view of one of the fingers of the hand, showing the finger body in cross-section.

Figure 5 is a top plan view of the finger shown in Figure 4, a portion of the finger body being cut away to show the construction of the operating mechanism.

Figure 6 is a cross-sectional view through a finger, the position of the section being indicated by the line 6-6 of Figure 5.

The body of the hand is shaped to simulate the body of a natural human hand, as best illustrated in Figure 1 of the drawing. The hand body, which is indicated in general by the numeral 10, extends from the wrist to the base of the fingers. A portion of the back of the hand is hollowed out to provide an aperture 11 forming a recess in which much of the operating mechanism for the hand is positioned. The wrist end of the hand may be provided with any suitable attaching mechanism such as 12, and may be fastened to the stump of the forearm, or may be connected to an artificial arm.

As described in my previous application above referred to, adjacent the base of the fingers I provide an anchoring means to which the fingers may be pivoted along one edge of the recess 11. I secure an anchoring plate 13. The plate 13 has anchoring holds or notches 14 through which screws or pins, not shown, may extend to hold the plate in proper position. The anchor plate 13 extends forwardly from the hand body and inclines downwardly therefrom. This plate is then bent at substantially right angles to form a finger portion 15 which is rigidly secured to the hand body. This rigid finger is not a necessary part of the hand but is desirable for use in carrying articles when it is so desired to use the hand. Alternatively the hand may be provided with a series of pivoted links in the manner described in my previous application. A tip end 16 is provided on the finger end to which one end of the finger body is secured. The manner in which the finger body is secured between the finger tip and the hand body will be later described in detail.

The anchoring plate 30 is provided for the third finger. This plate has holes 31 there-through, through which anchoring pins may be driven to hold this plate 30 in proper position in the hand body 10. This anchoring plate 30 is provided with a rounded tip end to which a link 32 is pivoted by means of a pivot 33. The link 32 is formed with opposed sides and a connecting top edge 34 designed to engage a shoulder 35 on the anchoring plate 30 in extended position of the finger to limit the pivotal movement in one direction.

A second link 36 is pivoted at 37 between the sides of the link 32. This link 36 is provided with an anchoring tip molded into the finger tip 40.

The second finger is provided with an anchoring plate 43 having apertures 44 through which anchoring pins may be driven to hold the plate in adjusted position. A rounded end is provided on the plate 43 and a link 45 is pivoted thereto at 46. The link 45 is formed of opposed sides and a connecting top portion 47 which is designed to engage a shoulder 49 on the anchoring plate 43 to limit pivotal movement in one direction.

A second link 50 is pivoted at 51 between the

sides of the link 45 and a finger tip 52 is cast upon the end thereof. A shoulder 54 on the link 50 is designed to engage the top portion 47 of the link 45 in extended position of the finger to limit the pivotal movement between the links 45 and 50. A similar shoulder 56 is provided on the link 36 which limits the pivotal movement of this link by engaging the top edge 34 of the link 32.

The first or forefinger is similar in construction to the other fingers. An anchoring member 57 is provided with aperture 59 through which means may extend to anchor the plate 57 to hand body 10. A rounded end is provided on the plate 57 and link 60 is pivotally connected thereto at 61. The link 60 is provided with opposed sides and a connecting top edge 62 which in extended position engages a shoulder 63 on the plate 57 to limit pivotal movement.

A second link 64 is pivoted at 65 between the side of the link 60 and supports finger tip 66. A shoulder 69 on the link 64 engages the top edge 62 of the link 60 in extended position of the fingers to limit pivotal movement.

The thumb of the hand is formed by a long curved lever 70 which is pivoted upon a pivot pin 71 supported by the body of the hand 10. A thumb tip 72 is cast or secured on the end of the lever 70.

An ear 74 is provided on the anchoring plate 13 and a pivot bolt or pin 75 secures a lever 76 pivotally thereto. This lever is urged into one extreme position by the tension spring 77, one end of which is secured to the lever 76. The other end of the spring is adjustably secured extending through a longitudinally extending aperture in the hand body and is secured by a washer 82 to the hand body. The washer 82 is adjustable to vary the tension of the spring 77.

A lever 84 is pivoted to the free end of the lever 76 being secured to the threaded end 85 of the thumb lever 70. The lever 84 is connected by link 86 to a fixed point on the body 10, such as the anchoring member 43. A cord 87 is secured to a yoke 89 which is pivotally attached to the end of the lever 84 and the end thereof pivots to the lever 76. By pulling on the cord 87 the lever 84 is pivoted about its fulcrum point, which in this case is the point of attachment with the link 86. As this pivot point is in front of the lever 76 the pivoting of the lever 84 acts to move the end of the lever 84 attached to the lever 76 forwardly toward the fingers stretching the spring 77 and pivoting the lever 76 toward the fingers.

A push rod 93 connects the lever 76 to the link 36 to operate the links 36 and 32. The push rod is bent to extend pivotally through the lever 76 and the other end thereof extends through the link 36. Forward movement of the lever 76 acts to push the links 36 and 32 into extended position. The opening 94 in the link 36 is at the proper distance from the pivot 37 to give the desired movement to the finger.

A push rod 95 is loosely linked through the lever 76 and connects this lever with the link 50 of the second finger. The rod 95 extends through an aperture 96 in the link 50 which is at the proper distance from the pivot 51 to provide the desired amount of movement of the second finger.

A push rod 97 is loosely linked through the lever 76 and is bent to extend through an opening 99 in the link 64. The aperture 99 is at a desired distance from the pivot 65 to provide

desired amount of movement of the first or fore-finger.

The thumb is operated by the lever 70 pivoted at 71. The inner end 85 of the lever 70 is loosely extended through the lever 76 and forward movement of the lever 76 pivots the top end of the lever forwardly, thereby pivoting the thumb away from the other fingers.

Each of the fingers is formed as best illustrated in Figures 4, 5, and 6 of the drawing. In these figures the second finger is shown but it will be understood that all of the fingers are similar in general construction. The anchoring plate, such as 43, is provided with an anchoring notch 100, while the link 50 which is embedded in the tip 52 is provided with an outward projection 101 bearing notch 102 therein. A spring coil 103 extends between the anchor plate 43 and the finger tip 52 being anchored at one end in the notch 100 and at the other end in the notch 102. The spring 103 is embedded in a coating of soft rubber or other suitable flexible resilient material 104 so as to completely enclose the spring 103. The mechanism of the fingers is concealed from view by this construction and a smooth surface is imparted to the fingers, thus presenting a more natural appearance than was previously considered possible. The rubber coating 104 has several advantages. This coating provides a smooth appearance to the fingers, it provides a smooth foundation to the glove covering the hand, it insulates the mechanism from contact with the coil spring, it deadens any sound made by the operating members, it prevents the coil from rubbing together, it also prevents moisture or dust from entering the finger bodies; thus this construction is of decided advantage.

Each of the fingers is provided with a cushioning pad 105 between the links and the outer body of the finger. This cushion pad 105 may be of felt or other suitable material and acts to prevent side strain upon the fingers from urging the coil spring out of alignment with the finger links. The pad 105 is positioned on the side of the links opposite the side on which a push rod operates. This is for two reasons: first because in this way the pads do not interfere with the operation of the fingers or of the push rods; secondly, because virtually all of the strain upon the fingers comes from the opposite side of the fingers; and finally because the push rods prevent, to some extent, distortion of the fingers by pressure from the opposite direction. I have shown, however, an auxiliary pad 106 extending a portion of the length of the fingers beyond the ends of the various operating push rods.

The lever 84 extends forwardly and upwardly from its pivotal connection with the lever 76. Because of the position of the pivotal connection of the link 84 and the link 86 there is a tendency for the lever 84 to pivot upwardly at its forward end, if pressure is exerted upon the fingers, tending to flex the fingers into open or elongated position. This pressure will not pivot the link 84 about its pivot point but rather will tend to raise the forward end of this lever 84. In order to prevent force upon the fingers from spreading the fingers into open position, I provide a rearwardly extending projection 107 on the anchoring plate 43 and provide a transverse curved finger 109 extending laterally from the projection 107. The finger 109 is provided with an upwardly curved free end 110 to guide the lever 84 beneath the finger 109 as the end of the lever 84 is at all times beneath the finger

109 when the fingers of the hand are not engaging with an object. Finger 109 will lock the fingers from accidental opening. The forward end of the lever 84 is prevented from being pulled upwardly by strain upon the fingers, thus holding the fingers locked in any position thereof. As the pull of the cord 87 is in a downward and rearward direction the finger 109 does not affect the operation of the fingers in opening or closing when it is desired to do so.

The finger 109 takes the place of a ratchet I previously provided on the anchoring plate 43 and which sometimes caused difficulty in operation. As the lever 84 has a tendency to move up and down at its forward end, this end of the lever sometimes engaged against the teeth of the ratchet holding the fingers from closing into extreme closed position. With the present construction the fingers are effectively locked and this previous difficulty is overcome.

In order to hold the link 86 in its extreme position and to assist in keeping the movement of the lever 84 I provide a spring 114 which is secured at one end to the link 86 and at its other end is anchored within the body of the hand 10. This side pull upon the link 86 also assists in preventing the fingers from being accidentally flexed into open position.

Each finger tip, such as the tip 52, is provided with a recess 111 in which is positioned a curved plate 112 simulating a finger nail. Each plate 112 extends beyond the remainder of the tip, and may be of use in picking up coins or other small objects. This construction is of considerable advantage over the former types of construction in which no such plates were provided.

In accordance with the patent statutes I have described the principles of construction and operation of my mechanical hand and while I have endeavored to set forth the best embodiments thereof, I desire to be understood that these are only means of carrying out my invention and that obvious changes may be made within the scope of the following claims without departing from the spirit of my invention.

I claim:

1. A mechanical hand comprising a hand body, a series of fingers articulated thereupon, an actuating mechanism for moving said fingers, means secured to said actuating mechanism for operating the same, each finger including a series of pivoted links, a tip end on one of said links, a metal coil encircling said links and connecting said tip end to said hand body, and a hollow tubular body of flexible resilient material embedding said metal coil between the inner and outer surfaces thereof.

2. An artificial hand comprising a hand body, fingers articulated thereon, said fingers comprising anchoring plates secured to said hand body; link means pivoted to said anchoring plates, a tip end on the outermost end of said link means, a hollow metal coil connecting said anchoring plates and said tip end, and an actuating means secured to said link means, and a pad means interposed between said link means and said metal coil.

3. A mechanical hand finger comprising an anchoring plate, a link pivotally secured thereto, a second link pivoted to said first named link, a finger tip on said second link, a tubular resilient finger body enclosing said links and connecting said tip to said anchoring plate, and pad means between said links and one side of said finger body.

4. A mechanical hand finger comprising an anchoring plate, a link pivotally secured thereto, a second link pivoted to said first named link, a finger tip on said second link, a link operating member secured to second link and extending along one side of said links, a tubular resilient finger body connecting said finger tip and said anchoring plate and enclosing said links and operating member, and a pad means between the other side of said links and said tubular body.

5. A mechanical hand finger comprising an anchoring plate, a link pivotally secured thereto, a second link pivoted to said first named link, a finger tip on said second link, a tubular resilient finger body connecting said finger tip to said anchoring plate and enclosing said links, and a felt pad having one side thereof contacting said links and having the other side thereof engaging the inner surface of said finger body.

6. An artificial hand comprising a hand body, a series of fingers articulated thereupon, a finger actuating means secured to each finger, a lever pivoted at one end thereof to said hand body, said finger actuating means being pivotally attached to said lever, a second lever pivoted at one end to the other end of said first named lever, means pivotally supporting said second lever intermediate the ends thereof, a pull cord secured to the other end of said second lever, and a locking finger engaging said other end of said second lever.

7. An artificial hand comprising a hand body, a series of fingers articulated thereupon, a finger actuating means secured to said fingers for actuating the same, a first lever pivotally secured to said hand body and pivotally secured to said finger actuating means to actuate the same in unison, a second lever having one end pivoted to said first lever at a point spaced from said pivotal attachment to said hand, a link pivotally connecting said second lever intermediate its ends to said hand body, a locking finger beneath which said second lever pivots, and a cord secured to the other end of said second lever to pivot said second lever.

8. An artificial hand comprising a hand body,

a series of fingers articulated thereupon, a finger actuating means secured to each finger, a lever pivoted at one end thereof to said hand body, said finger actuating means being pivotally attached to said lever, a second lever pivoted at one end to the other end of said first named lever, means pivotally supporting said second lever intermediate the ends thereof, operating means secured to the other end of said second lever, and a locking finger engaging said other end of said second lever.

9. A mechanical hand finger including an anchoring member, a finger tip end, a metal coil connecting said anchoring member and said tip end, a hollow tubular finger body of flexible resilient material embedding said metal coil between the inner and outer surfaces thereof, and metal finger actuating mechanism within said tubular body.

10. A mechanical hand finger including a hollow tubular rubber sleeve shaped to simulate a finger, a finger end at one end of said rubber sleeve, an anchoring member at the other end of said sleeve, a metal coil embedded within said rubber sleeve between the inner and outer surfaces thereof, and metal finger actuating mechanism within said rubber sleeve.

11. A mechanical hand finger including a hollow tubular rubber sleeve shaped to simulate a finger, a finger tip at one end of said sleeve, an anchoring member at the other end of said sleeve, said sleeve having outer and inner substantially smooth surfaces, a metal coil embedded in said sleeve between said smooth surfaces between the inner and outer surfaces thereof, and metal finger actuating mechanism within said hollow rubber sleeve.

12. An artificial hand comprising a hand body, a series of fingers articulated thereupon, each finger including a series of pivoted links, a tip end on the outermost end of said links, a metal coil encircling said links and connecting said tip end to said hand body, and a pad means interposed between said links and said metal coil.

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