

Jan. 10, 1950

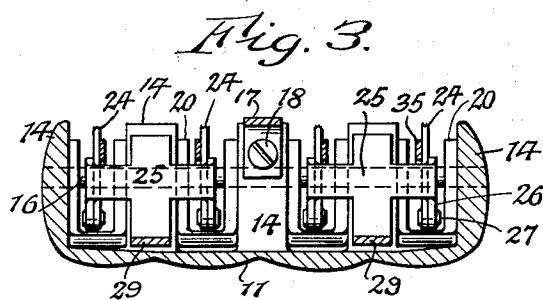
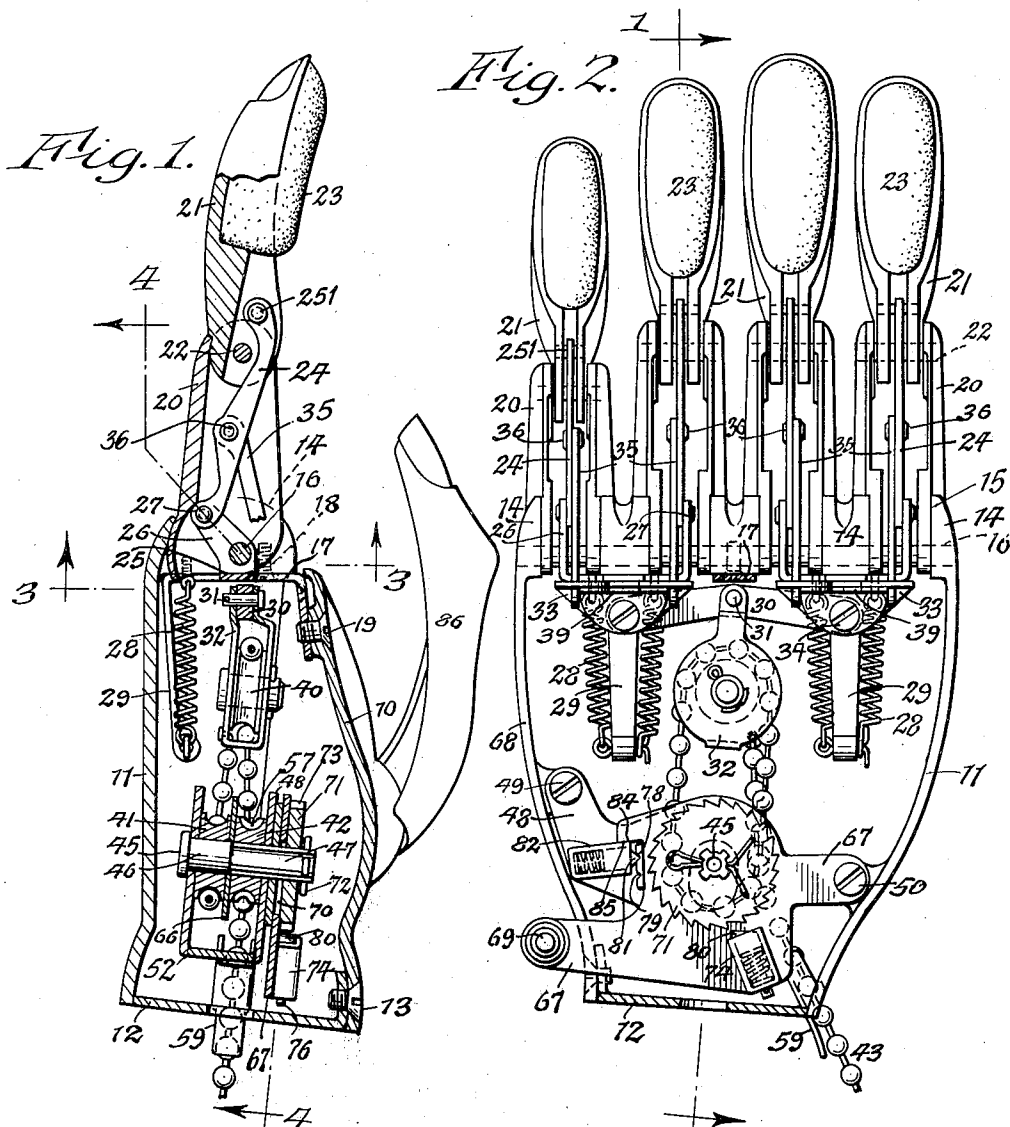
A. PECORELLA ET AL

2,493,776

ARTIFICIAL LIMB

Filed Dec. 4, 1946

3 Sheets-Sheet 1



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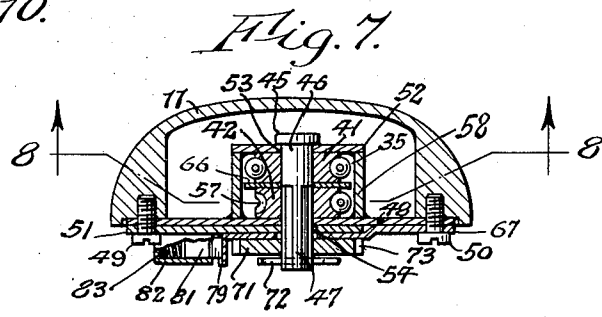
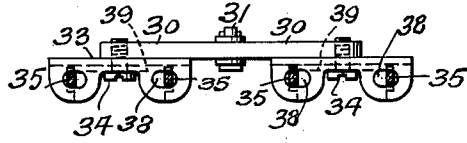
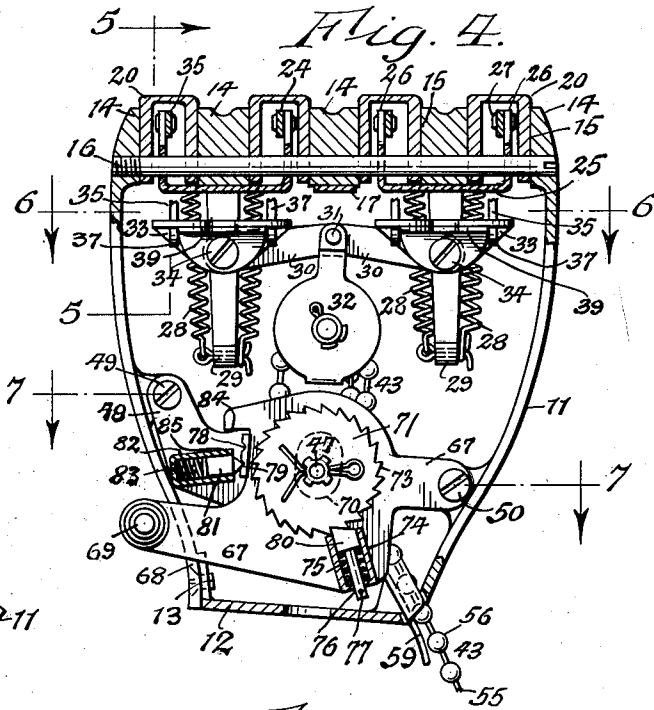
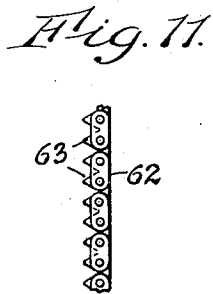
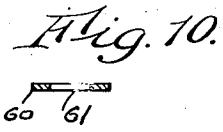
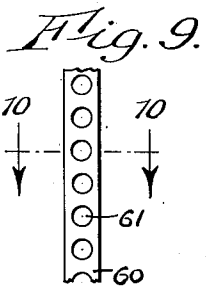
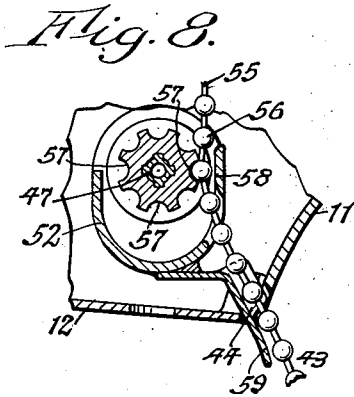
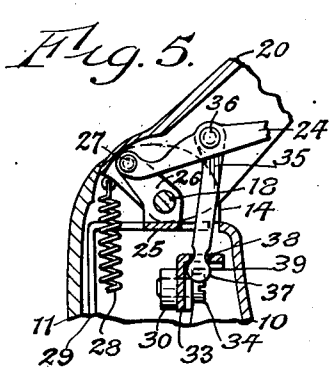
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3 Sheets-Sheet 2



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ARTIFICIAL LIMB

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Filed Dec. 4, 1946

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Fig. 13.

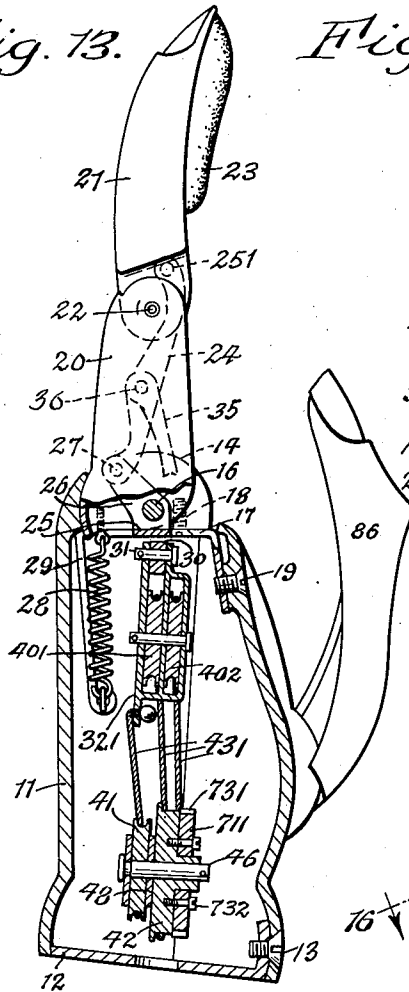


Fig. 14.

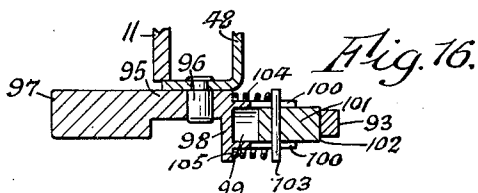
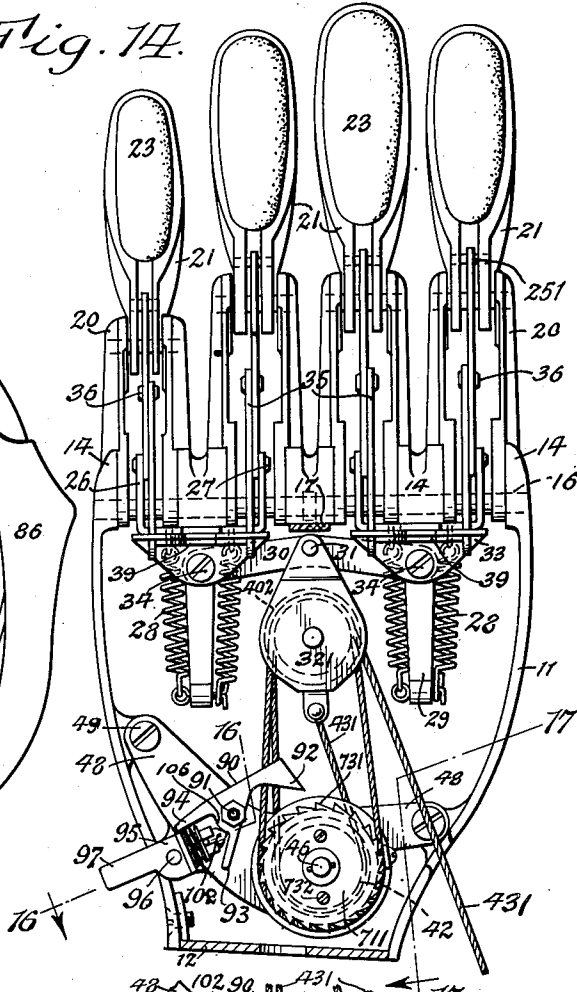


Fig. 16.

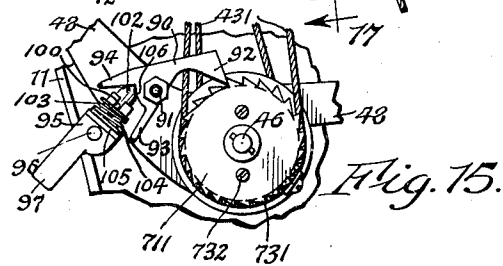


Fig. 15.

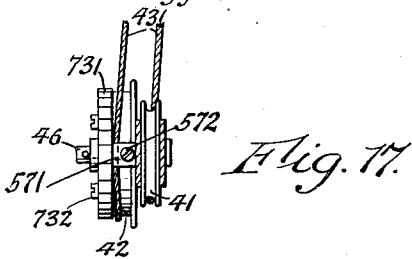


Fig. 17.

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UNITED STATES PATENT OFFICE

2,493,776

ARTIFICIAL LIMB

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Application December 4, 1946, Serial No. 714,020

9 Claims. (Cl. 3-12)

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This invention relates to an artificial limb, and more particularly to an artificial hand of the general construction shown in Letters Patent of the United States Nos. 1,792,183 and 2,364,313.

The object of the present invention is to improve the means for mounting the fingers on the palm of the hand, also the means for opening and closing the fingers relative to the palm and also the means for holding the fingers in their closed position and releasing the same, and thereby permit of operating those members easily and closely to simulate the natural action of the same, and to render the same more durable and reduce the cost of manufacture.

In the accompanying drawings:

Fig. 1 is a longitudinal section of an artificial hand embodying this invention showing the fingers open or unfolded the fullest extent and taken on line 1-1, Fig. 2.

Fig. 2 is an elevation of the same viewed from the inner side of the hand and with the inner side of the palm and the thumb removed.

Fig. 3 is a cross section taken on line 3-3, Fig. 1, looking toward the fingers of the hand.

Fig. 4 is a longitudinal section taken on line 4-4, Fig. 1, looking toward the outer section of the palm.

Fig. 5 is a fragmentary sectional view, similar to Fig. 1, but showing the inner section of the respective finger in a partly folded or closed position, and taken on line 5-5, Fig. 4.

Figs. 6 and 7 are transverse sections taken respectively on lines 6-6 and 7-7, Fig. 4, and looking toward the wrist of the hand.

Fig. 8 is a fragmentary cross section taken on line 8-8, Fig. 7.

Fig. 9 is a fragmentary elevation of a modified form of operating line used in this device.

Fig. 10 is a cross section thereof taken on line 10-10, Fig. 9.

Figs. 11 and 12 are fragmentary elevational views showing additional alternate forms of pull lines for operating the mechanism of the artificial limb instead of that shown in Figs. 1, 2, 4, 7 and 8.

Fig. 13 is a longitudinal section of an artificial hand similar to Fig. 1 showing another modified construction of this invention.

Fig. 14 is an elevation of the same, partly in section similar to Fig. 2.

Fig. 15 is a fragmentary elevation of the pulley block and tackle mechanism shown in Fig. 14, but showing a different position of some of the parts.

Fig. 16 is a cross section, on an enlarged scale, taken on line 16-16, Fig. 14.

Fig. 17 is a fragmentary side elevation of part of the pulley block and tackle mechanism shown in Figs. 13-15 and viewed from line 17-17, Fig. 14.

In the following description like numerals of

2

reference indicate the same parts in the several figures of the drawings:

Referring to Figs. 1-7, the palm of the hand comprises hollow longitudinal front and back sections or plates 10, 11, the outer ends of which are separated and receive the fingers between them while the inner ends of the same receive between them a transverse wrist plate 12 to which they are detachably connected by screws 13. At its outer end the back palm section is provided with knuckle bearing lugs 14 which are arranged in a transverse row but separated from each other by spaces 15 adapted to receive finger sections which are pivotally connected with these bearing lugs by a transverse shaft or knuckle rod 16 passing through the several knuckle lugs and the respective finger sections. The upper part of the front palm section 10 is connected with central knuckle lug 14 by means which include an angle bracket 17 having an upper horizontal arm secured by a screw 18 to the underside of the central knuckle lug 14 and a lower vertical arm which is secured by a screw 19 to the inner side of the front palm section, as shown in Figs. 1, 2, 3, and 4.

At the outer end of the palm sections are arranged the four fingers of the hand each of which comprises a hollow inner section 20 pivoted at its inner end on the knuckle rod 16 between two adjacent knuckle lugs 14 and a hollow outer section 21 pivotally connected at its inner end with the outer end of the corresponding inner finger section 20 by a pin 22. The outer part of each outer finger section is preferably provided with a resilient pad 23 of sponge rubber or the like for causing the same to engage the part to be grasped with a soft or cushioning effect.

When using the fingers of this hand, the inner finger sections are folded inwardly toward the front palm section and the outer finger sections are folded toward the inner finger sections and the front palm section for closing the hand and a reverse movement of these finger sections restores the same to the unfolded position shown in Figs. 1 and 2 in which the hand is fully opened.

The mechanism whereby the sections of the fingers are caused to fold and unfold comprises the following elements:

The numeral 24 represents a plurality of longitudinal shifting links each of which is arranged lengthwise of the front side of the sections of one of the fingers and is pivotally connected at its outer end by a pin 25 to the inner part of one of the outer finger sections beyond the pivot pin 22 thereof. The four fingers constitute two pairs which are arranged side by side and the two shifting links 24 of each pair are operatively connected with the outer end of the back

palm section 11 by means which include an anchoring bracket having a cross bar 25 which engages its central part with the underside of the adjacent intermediate knuckle lug 14, and two pivot arms 26 projecting upwardly and backwardly from opposite ends of this cross bar and each pivotally connected with the inner end of one of the shifting links 24 by a pivot pin 27, as shown in Figs. 1, 2, 3, 4 and 5. Each of the anchoring brackets is supported on the respective knuckle lug 14 by passing the knuckle shaft or rod 16 through openings formed in the arms 26 of this bracket between its cross bar and the pivot pins 27 thereof, thereby forming a rigid and durable construction.

Upon pulling longitudinally inwardly on the shifting links 24 the outer sections of the fingers are folded inwardly on the inner finger sections and the inner finger sections are folded inwardly relative to the palm section and when this pull is released the sections of each finger are again restored to their outwardly unfolded, straight or open position, shown in Figs. 1 and 2, by a vertical spring 28 having its upper end connected with the lower end of the adjacent inner finger section 20 in rear of its pivot 18 while its lower end is connected with a vertical arm 29 depending from the rear central part of the cross bar 25 of the adjacent anchoring bracket as shown in Figs. 1, 2, 4, and 5.

Below the several fingers and within the space between the upper ends of the front and back sections of the hand is arranged a main equalizing lever or bar which is pivoted between its arms 30 by a pin 31 on the upper end of a longitudinally movable yoke 32. On the outer end of each arm of the main equalizing lever is pivotally mounted an auxiliary equalizing lever or bar the central part of which between its arms 33 is pivoted on the respective arm of the main equalizing lever by a screw 34. The numeral 35 represents a plurality of operating links each of which is pivoted at its upper end by a pin 36 to one of the shifting links 24 between its ends while the lower end of this link is pivoted by a swivel joint to one arm 33 of one of the auxiliary equalizing levers. In its preferred form this swivel joint, as best shown in Figs. 2, 4, 5 and 6 comprises a flat swivel head 37 which is passed downwardly through a horizontal slot 38 in one arm 33 of the auxiliary equalizing lever and then turned one-quarter so that this head is arranged at right angles to said slot and bears upwardly against the respective arm of the auxiliary equalizing lever, and an angular retaining plate 39 which is secured to this auxiliary equalizing lever and bears at its opposite ends against the opposing flat sides of a respective pair of links 35 so as to hold the same in the outer parts of the slots 38, as shown in Fig. 6, and thereby preventing said swivel heads from turning into alinement with said slots and escaping therefrom. This retaining plate is preferably attached to its respective auxiliary equalizing lever by the screw 34 which pivotally connects this auxiliary equalizing lever with the main equalizing lever.

Upon moving the yoke 32 downwardly the main and auxiliary equalizing levers are moved in the same direction and cause the finger sections to fold in unison but if the finger sections are arrested at different places due to engaging an irregular surface on the object which is being grasped the main equalizing lever will rock on the yoke 32 and the auxiliary equalizing levers

will rock on the fulcrum screws 34 of the main equalizing lever and thus compensate for the irregularities of this surface as the finger sections adapt themselves thereto, whereby a uniform grip is obtained for securely holding the object. The downward or closing movement of the finger sections is effected by a manually operated closing means connected with the yoke 32 and the opening or unfolding of the same is effected by spring means, the closing and opening means embodying the present invention and in their preferred form being constructed as follows:

The numeral 40 represents a floating or running pulley which is pivotally mounted within the yoke 32 and in effect forms a pulley-block therewith.

Below this pulley-block and in the space between the front and rear sections of the palm a pair of pulleys 41, 42 are arranged axially side by side and mounted upon a support so as to be capable of either turning together or rotating independently of each other. The pulleys 41, 42 form part of a fall or tackle for opening and closing the fingers and in this case the pulley 41 will be designated as a standing intermediary idle pulley and the pulley 42 as a gear or locking pulley. The floating pulley 40 and the idle pulley 41 are provided with a smooth peripheral bearing surface and the locking pulley 42 is constructed so as to form in effect a sprocket or chain wheel.

The numeral 43 represents an operating line, chain or belt which has one end connected with the lower part of the yoke 32 of the pulley-block and thence passes downwardly around the intermediate or idle pulley 41, thence upwardly and over the floating pulley 40 of the pulley-block, thence downwardly past a part of the periphery of the locking pulley 42 and in geared engagement therewith, and thence downwardly through an opening 44 formed in the corner between the lower part of the rear palm section 11 and the adjacent part of the wrist plate 12.

Upon pulling downwardly on the lower end of this operating chain or line when no object is grasped by the fingers, the pulley-block is moved downwardly together with the main equalizing lever 30, the auxiliary equalizing levers 33 and the links 35 which operatively connect the auxiliary equalizing levers with the finger sections and thereby cause these fingers to be closed. Upon releasing the pull on the operating line these parts move in the opposite direction and permit the fingers to open by the pull of the springs 28. During this action the sections of the several fingers move in unison with the pulley-block upon being closed and opened. When, however, the pulley-block is moved downwardly while the closing movement of one or more of the fingers is arrested by engagement with an object which is grasped, then the final part of the downward movement of the pulley-block is effected independently of one or more of the finger sections, but the respective springs 28 of such finger sections are stretched more or less upon completing the downward movement of the pulley-block. During the initial part of the subsequent upward movement of the pulley-block those finger sections which were not arrested during the closing movement are unfolded until they are in line with the sections of those fingers which were arrested during the closing movement and thereafter all of the finger sections will be returned to their fully opened po-

sition by the tension of their respective springs 28.

Although the intermediate idle pulley 41 and locking pulley 42 may be mounted in any suitable manner so as to turn about a fixed axis this is preferably accomplished as follows:

The numeral 45 represents a horizontal axle, shaft or pin extending centrally through the intermediate pulley 41 and the locking pulley 42, that portion of this axle which is arranged within the intermediate pulley having a smooth cylindrical surface 46 so that this pulley is free to turn thereon, but that portion of this axle which passes through the locking pulley is provided with a spline 47 which interlocks this locking pulley and compels the same to turn together.

This axle is mounted on a stationary support arranged within the lower part of the space between the front and rear sections of the palm and preferably comprises a main cross plate or bar 48 which is connected at its opposite end by means of screws 49, 50 with the inner side of the rear section of the palm, a reinforcing plate 51 arranged in the front of the main supporting bar and secured to the rear palm section by means of the screw 49, and a housing shaped bracket 52 projecting rearwardly from the rear side of the main supporting bar 48, as best shown in Figs. 1, 4 and 7. At its inner end the axle turns in a bearing opening 53 in the inner part of the housing bracket, and adjacent to its outer end this axle turns in a bearing opening 54 formed in the adjacent central parts of the main supporting plate or bar 48 and its reinforcing plate 51, as shown in Figs. 1 and 7.

In Figs. 1, 2, 4, 7 and 8 the operating line is represented in the form of a gear chain or belt which is composed of a longitudinal cord or cable 55 and a plurality of gear balls 56 secured at intervals on this cord and adapted to interlock successively with annular gear pockets 57 on the periphery of the locking pulley 42, as shown in Figs. 7 and 8, this gear chain or belt however, being free to slide around the periphery of the intermediate idle pulley 41 and the floating pulley 40 inasmuch as the idle pulley and the floating pulley are smooth on their peripheries. Due to this construction of the operating line and the locking pulley the latter is turned forwardly when the operating line is pulled downwardly, and when the operating line is pulled backwardly by the springs 28 the locking pulley is turned backwardly.

In order to retain the lower stretch of the operating line in mesh with the locking wheel during the downward and upward movements of this stretch of the operating line, retaining guide means 58 are provided on the housing bracket 52, as shown in Figs. 7 and 8, which are arranged opposite to that part of the periphery of the locking pulley where the same is engaged with the operating line and thereby maintains this locking wheel pulley and operating line in geared relation.

The lowermost stretch of the operating line is also guided to and from the locking pulley 42 adjacent to the opening 44 in the rear section of the palm by means of a guide 59 extending from this opening to the lower part of the housing bracket 52 as shown in Figs. 1, 2, 4 and 8.

Instead of making the operating line in the form of a cord or cable which is provided at intervals with gear balls which are adapted to interlock with gear pockets in the locking pulley, any other form of operating line may be em-

ployed which can be maintained in geared relation with the locking pulley while passing on and off the latter. For example, as shown in Figs 9 and 10, a flat belt 60 having a longitudinal row of openings 61 may be employed which are adapted to engage with an annular row of teeth on a locking wheel similar to the pulley 42 shown in Fig. 8. In Fig. 11 a link chain belt 62 is shown which has some of its links provided with teeth 63 adapted to engage teeth arranged in an annular row on the locking pulley 42 and thereby causes this belt and the respective locking pulley to move in geared relation. Likewise, as shown in Fig. 12, the operating line may be constructed in the form of an ordinary chain belt 64 the links of which are provided with openings 65 which are adapted to receive teeth on the locking pulley 42 so as to operatively connect the same in a manner well known in the driving gear of bicycles.

In the preferred manner of mounting the idle or intermediate pulley 41 and the locking pulley 42 these pulleys are separated by an intervening plate 66 which is mounted on the central part of the axle 45, and the locking pulley engages its front side with the rear side of the cross bar 48 while the rear side of the idle pulley 41 engages with the rear part of the housing bracket 52, as shown in Figs. 1 and 7.

Controlling or locking means are provided whereby the fingers may be held in a more or less folded position and also released so as to permit the same to freely fold and unfold, which means include the locking gear pulley 42 and the operating line or chain belt 43 and are constructed as follows:

The numeral 67 represents a vertically swinging controlling lever which is arranged transversely in the lower part of the space between the front rear sections of the palm and adjacent to the front side of the supporting bar 48 and its reinforcing plate 51. The inner end of this controlling lever is pivoted on the rear palm section by means of the same screw 50 which connects one end of this supporting bar with the rear palm section and the opposite end of this lever projects laterally through a longitudinal slot 68 in the opposite part of the palm and is provided on the exterior of the latter with a finger piece or handle 69 whereby this lever may be raised and lowered. On its central part this controlling lever is provided with a slot 70 through which the front part of the axle 45 passes, this slot being sufficiently long to permit the controlling lever to be raised and lowered the requisite distance without interfering with this axle. The numeral 71 represents a ratchet wheel which is arranged in front of the controlling lever and mounted on the adjacent front part of the axle so as to be compelled to be turned therewith. This connection between this ratchet wheel and the axle is effected by continuing the spline 47 on the axle forwardly to the front end of the later and engaging this spline with correspondingly shaped notches in the bore of the ratchet wheel, as shown in Figs. 1, 2, 4, and 7. The ratchet wheel is retained on the front end of the axle by means of a cotter pin 72 passing through this axle in front of the ratchet wheel.

On the lower part of the controlling lever is mounted a detent pawl 80 which is adapted to be moved into and out of the path of the teeth 73 of the ratchet wheel for the purpose of either permitting the latter to turn freely backwardly as well as forwardly and also permitting of locking this ratchet wheel so as to hold the same against

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backward movement. This detent pawl is slidably mounted on the controlling lever so as to permit the same to move radially relative to the axis of the ratchet wheel for which purpose the controlling lever is provided with a guide way or pocket 74 which receives this detent pawl, as best shown in Fig. 4. This detent pawl is constantly urged toward the path of the teeth of the ratchet wheel by means of a spring 75 interposed between the detent pawl and the bottom of the pocket 74. The movement of the detent pawl upwardly in this guideway is limited by means of a stop rod 76 projecting from this detent pawl downwardly through the spring 75 and through the bottom of the guide pocket 74 and a stop pin 77 connected with the lower end of this stop rod and adapted to engage the lower end of the guide pocket.

When the controlling lever is moved into its lowermost position, as indicated in Fig. 2, the detent pawl is moved downwardly into a position outside of the path of the ratchet wheel teeth, thereby permitting this ratchet wheel and the gear pulley 42 to be freely rotated back and forth by pulling downwardly on the operating line and releasing the pull thereon so that the springs 28 can pull this line and the parts associated therewith in the opposite direction. When, however, it is desired to prepare the controlling mechanism so that it locks and holds the fingers in whatever position they may have been moved by a downward pull of the operating line and thereby maintain the hold of the fingers on the surface of the article which has been grasped, the controlling lever is first raised into its highest position so that the detent pawl 80 is arranged in the path of the ratchet teeth and engages one of these teeth, as shown in Fig. 4. Upon now pulling downwardly on the operating line the same will not only lower the pulley blocks 32, 40 and cause the several fingers to be closed more or less in adapting themselves to the surface of the article which is being grasped but also causing the teeth of the ratchet wheel during the forward rotation of the same to successively trip past the detent pawl. When the downward pull of the lower end of the operating line ceases the detent pawl will prevent the ratchet wheel from turning backwardly and thereby retain the several finger sections in engagement with the surface of the article which has been grasped. The several fingers will remain in this operative position and securely hold the object engaged thereby as long as the detent pawl is elevated and in engagement with the respective tooth of the ratchet wheel. When it is desired to release the grip of the fingers on the object which has been held, it is only necessary to lower the controlling lever so as to disengage the detent pawl from the teeth of the ratchet wheel and when this occurs the springs 28 cause the fingers to be unfolded and the operating mechanism associated therewith to return to its retracted position.

Means are provided for yieldingly holding the operating lever either in its elevated operative or in its depressed inoperative position which means in their preferred form are constructed as follows and best shown in Figs. 2, 4 and 7.

The numerals 78, 79 represent upper and lower locating notches or recesses formed on the upper part of the controlling lever and 81 represents a locating dog which is yieldingly mounted on an adjacent relatively stationary part of the palm and provided with a V-shaped front end which is adapted to engage with either one or the other

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of the locating notches 78, 79. This locating dog is slidably mounted in a guide pocket 82 arranged on the adjacent part of the supporting bar plate 51 and is yieldingly held in its projected position by means of a spring 83 arranged in this pocket and bearing at its opposite ends against the bottom of this pocket and the rear end of this dog. Upon moving the controlling lever downwardly into its lowermost position as indicated in Fig. 2, this locating dog engages with the upper locating notch 78, and upon moving this lever into its uppermost position this locating dog engages with the lower locating notch 79, thereby causing the ratchet pawl 80 to be either moved out of the path of the ratchet teeth and permitting the fingers to be freely folded or unfolded upon pulling the operating chain or line or releasing the same. By raising the operating lever so that the locating dog engages with the lower locating notch the detent pawl is moved into the path of the ratchet teeth 73, as shown in Fig. 4 whereby the sectional fingers upon being folded more or less by a pull on the operating line will be locked in engagement with the article which has been grasped and permit the pull on the operating line to be relaxed without releasing the grip of the fingers and palm on this article. Whenever it is desired to release the grip of the hand on the article which is grasped it is only necessary for the controlling lever 67 to be pushed downwardly from its elevated operated position shown in Fig. 4 to its lowered inoperative position, as shown in Fig. 2. By this means the operating lever is yieldingly held in either of these positions and upon moving this lever from one position to the other the locating dog is retracted by the wedge action of the elevated part of the controlling lever between the two locating notches 78, 79 against this dog which latter is again projected into the respective notch by the resilience of the spring 83.

In the preferred construction the downward movement of the controlling lever is positively limited by means of a stop 84 formed on the upper part of this lever and engaging with the stop surface 85 which is preferably formed by the upper side of the guide pocket 82 on the supporting bar, as shown in Fig. 2.

The upward movement of the controlling lever may also be limited by any suitable means for instance by engagement of the guide pocket 74 of the detent pawl with the underside of the ratchet wheel 71 as shown in Fig. 4.

On the front plate 10 of the palm, a thumb 86 is mounted for cooperation with the palm and fingers of the hand, which thumb may be operated in any suitable manner.

An alternative form of the pulley block and tackle mechanism and detent or locking mechanism is shown in Figs. 13-17 and constructed as follows:

Instead of employing a single running pulley 40, as shown in Fig. 1, two running pulleys 401, 402 may be mounted on the yoke or block 321 as shown in Figs. 13 and 17 and a pull or operating line 431 having the form of a cable may be employed which has its inner end connected with the yoke 321 and passes from thence successively downwardly and under the idle intermediate pulley 41, thence upwardly and over the running pulley 401, thence downwardly and under the locking pulley 42, thence upwardly and over the running pulley 402, and thence downwardly and through the opening between the hand plates 10, 11 to the exterior of the hand where the outer end of the operating line

is accessible for manipulation. A locking ratchet wheel 711 having peripheral ratchet teeth 731 is connected by screws 732 with the pulley 42 and these are caused to move in unison with the operating line by means of a clip 571 which is connected with the pulley 42 by a screw 572 and clamps the cable 431 against the periphery of the pulley 711, as shown in Figs. 14, 15 and 16.

Upon pulling downwardly on the outer end of the operating cable or line the floating yoke and running pulleys 401, 402 will be moved downwardly together with the parts operatively connected therewith and cause the articulated fingers to close or fold and when the pull on this operating cable is released the springs 28 raise the pulleys 401, 402 and open or unfold the fingers.

By using a pulley block and tackle mechanism in the manner shown the closing and opening of the sectional fingers can be effected very easily and with the expenditure of relatively little power.

The means shown in Figs. 13-17 for holding the fingers in a closed position and retain a grip of the same on the article which is to be held are constructed as follows:

The numeral 90 represents a detent pawl or dog which is pivoted by means of a pin 91 on the stationary cross bar 48 and provided at its inner end with a tooth or beak 92 adapted to be moved into and out of engagement with the teeth 731 of the locking wheel 711. The outer end of this pawl is provided with lower and upper shifting lugs 93, 94 which are spaced circumferentially from each other, as shown in Figs. 14 and 15. On the adjacent part of the bar 48 a shifting lever 95 is pivoted by means of a pin 96. The outer arm 97 of this lever projects through a slot in the respective plate to the exterior of the hand so that the same may be manipulated and its inner arm 98 is provided with a radial guide socket 99 and longitudinal retaining slots 100 on opposite sides of this socket. The inner arm 98 of the shifting lever projects into the space between the shifting lugs 93, 94, and in its guide socket a plunger 101 slides lengthwise. This plunger is provided with a V-shaped inner end 102 which is adapted to engage either of these lugs and a transverse pin 103, the opposite ends of which project into the slots 100 for preventing turning of this plunger but permitting longitudinal movement of the same. The plunger is yieldingly held in engagement with the detent pawl between its shifting lugs by a spring 104 surrounding the inner arm 98 and resting at its inner and outer ends, respectively, against the ends of the pin 103 and a shoulder 105 on this arm of the shifting lever upon raising the outer arm 97 of the shifting lever so that the plunger engages with the lower trip lug 93 this lever will be turned so that the detent tooth 92 is disengaged from the ratchet teeth 731 of the locking wheel 711, thereby permitting the springs 28 to open the fingers, as shown in Figs. 13 and 14.

Upon depressing the outer arm 97 of the shifting lever the plunger 101 will engage the upper shifting lug 94 of the detent pawl and turn the latter so that its beak 92 engages the ratchet teeth 731 of the locking wheel, whereby the fingers upon being folded by a pull on the operating arm will be held against opening in whatever position they may be left.

Disengagement of the detent pawl from the locking wheel will permit the fingers to again resume their open position automatically due to

the pull of the springs 28. As the shifting lever is turned to operate the detent pawl the plunger 101 trips over the hub 106 of the detent pawl and compresses the spring 104 and at the end of the movement of these parts in either direction the plunger engages with the base of either of the lugs 93, 94 and the hub 106 of the detent pawl and yieldingly hold the latter in its operative or inoperative position.

As a whole this artificial hand is efficient in operation, the same can be conveniently manipulated, the several parts are not liable to get out of order and the same can be manufactured at comparatively low cost and also serviced economically.

We claim as our invention.

1. An artificial limb comprising a palm, fingers pivotally mounted on said palm, and means for folding and unfolding said fingers including: a bar connected with said fingers, a floating pulley connected with said bar, an idle pulley pivotally mounted on said palm, a locking pulley pivotally mounted on said palm and having a gear face, an operating line passing around said pulleys and having gearing engagement with the gear face of said locking pulley and a ratchet device associated with said locking pulley and adapted to be operated for permitting said locking wheel to turn freely forwardly and backwardly or to only permit said locking wheel to turn forwardly but prevent backward movement of the same.

2. An artificial limb comprising a palm, a plurality of fingers pivotally mounted on said palm, and means for folding and unfolding said fingers including a bar connected with said fingers, a pulley block having a yoke connected with said bar and a floating pulley pivoted on said yoke, an idle pulley mounted on the palm, a locking pulley mounted on the palm, an operating line passing around the faces of said floating and idle pulleys and having a gearing engagement with said locking wheel and having one of its end parts connected with said yoke and its other end part adapted to be pulled and released, and a ratchet device operable selectively to permit said locking pulley to turn freely in either direction or to permit the same to only turn forwardly but to be held against backward rotation.

3. An artificial limb comprising a palm, a plurality of fingers pivotally mounted on said palm, and means for folding and unfolding said fingers including a bar connected with said fingers, a pulley block having a yoke connected with said bar and a floating pulley pivoted on said yoke, an idle pulley mounted on the palm, a locking pulley mounted on the palm, an operating line passing around the faces of said floating and idle pulley and having a gearing engagement with said locking wheel and having one of its end parts connected with said yoke and its other end part adapted to be pulled and released and a ratchet device operable selectively to permit said locking pulley to turn freely in either direction or to permit the same to only turn forwardly but to be held against backward rotation, said ratchet device including a ratchet wheel turning with said locking pulley and having a row of ratchet teeth, a support mounted on said palm and movable relative to the axis of said ratchet wheel and a spring pressed pawl mounted on said support and movable into and out of the path of said ratchet teeth.

4. An artificial limb comprising a palm, a plurality of fingers pivotally mounted on said

palm, and means for folding and unfolding said fingers including a bar connected with said fingers, a pulley block having a yoke connected with said bar and a floating pulley pivoted on said yoke, an idle pulley mounted on the palm, a locking pulley mounted on the palm, an operating line passing around the faces of said floating and idle pulleys and having a gearing engagement with said locking wheel and having one of its end parts connected with said yoke and its other end part adapted to be pulled and released and a ratchet device operable selectively to permit said locking pulley to turn freely and in either direction or to permit the same to only turn forwardly but to be held against backward rotation said ratchet device including a ratchet wheel turning with said locking pulley and having a row of ratchet teeth, a controlling lever movable relative to the axis of the locking pulley and having an inner part pivoted to the inner part of the palm and an outer part accessible on the exterior of the same, and a spring loaded pawl mounted on said lever and movable into and out of the path of said ratchet wheel.

5. An artificial limb comprising a palm, a plurality of fingers pivotally mounted on said palm, and means for folding and unfolding said fingers including a bar connected with said fingers, a pulley block having a yoke connected with said bar and a floating pulley pivoted on said yoke, an idle pulley mounted on the palm, a locking pulley mounted on the palm, an operating line passing around the faces of said floating and idle pulleys and having a gearing engagement with said locking wheel and having one of its end parts connected with said yoke and its other end part adapted to be pulled and released, and a ratchet device operable selectively to permit said locking pulley to turn freely in either direction or to permit the same to only turn forwardly but to be held against backward rotation, said ratchet device including a ratchet wheel turning with said locking pulley and having a row of ratchet teeth, a support mounted on said palm and movable relative to the axis of said ratchet wheel, a spring pressed pawl mounted on said support and movable into and out of the path of said ratchet teeth and yielding retaining means for holding said support in one position or another.

6. An artificial limb comprising a palm, a plurality of fingers pivotally mounted on said palm, and means for folding and unfolding said fingers including a bar connected with said fingers, a pulley block having a yoke connected with said bar and a floating pulley pivoted on said yoke, an idle pulley mounted on the palm, a locking pulley mounted on the palm, an operating line passing around the faces of said floating and idle pulleys and having a gearing engagement with said locking wheel and having one of its end parts connected with said yoke and its other end part adapted to be pulled and released, and a ratchet device operable selectively to permit said locking pulley to turn freely in either direction or to permit the same to only turn forwardly but to be held against backward rotation, said ratchet device including a ratchet wheel turning with said locking pulley and having a row of ratchet teeth, a support mounted on said palm and movable relative to the axis of said ratchet wheel, a spring pressed pawl mounted on said support and movable into and out of the path of said ratchet teeth, and yielding retaining means for holding said support in one position or another, including

two spaced notches formed on said support, and a spring loaded dog mounted on the palm and adapted to engage either one of said notches.

7. An artificial limb comprising a palm, a plurality of fingers movably mounted on said palm, and means for folding and unfolding said fingers including a floating pulley operatively connected with said fingers, an axle turning in a fixed bearing on said palm, an idle pulley rotatable on said axle, a locking pulley rotatable with said axle, an operating line passing around said floating and idle pulleys and having gearing engagement with said locking pulley, and controlling means for permitting said locking pulley to turn freely forwardly and backwardly or to permit the same to only turn forwardly but prevent backward rotation thereof.

8. An artificial limb comprising a palm, a plurality of fingers movably mounted on said palm, and means for folding and unfolding said fingers including a floating pulley operatively connected with said fingers, an axle turning in a fixed bearing on said palm, an idle pulley rotatable on said axle, a locking pulley rotatable with said axle, an operating line passing around said floating and idle pulleys and having gearing engagement with said locking pulley, and controlling means for permitting said locking pulley to turn freely forwardly and backwardly or to permit the same to only turn forwardly but prevent backward rotation thereof, including a ratchet wheel turning with said axle and provided with a row of ratchet teeth, a spring loaded detent pawl movable into and out of the path of said ratchet teeth and a movable support mounted on the palm and carrying said detent pawl.

9. An artificial limb comprising a palm, a plurality of fingers movably mounted on said palm, means for folding and unfolding said fingers interposed between said fingers and said palm and including a pulley block and tackle mechanism which is operable from the exterior of the palm and comprising floating pulley means movable bodily with said fingers, relatively stationary pulley means mounted on the palm, and tackle means passing around said floating and stationary pulley means and locking means for holding said fingers in a folded position including a ratchet wheel connected with said stationary pulley means, a detent pawl having a beak adapted to be engaged with and disengaged from the teeth of said ratchet wheel, and also having spaced shifting lugs, a shifting lever pivoted on said palm, a plunger guided on said shifting lever and adapted to engage either of said lugs, and spring means mounted on said shifting lever and engaging said plunger for yieldingly holding the detent pawl in its operative and inoperative position.

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