

June 19, 1951

M. J. MAGUTH
ARTIFICIAL ARM

2,557,792

Filed Jan. 27, 1949

3 Sheets-Sheet 1

Fig. 1

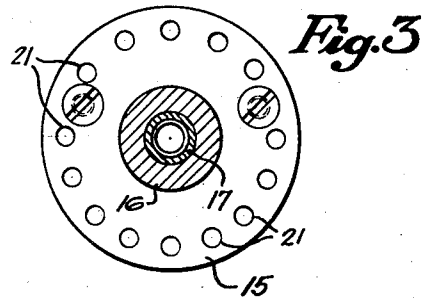
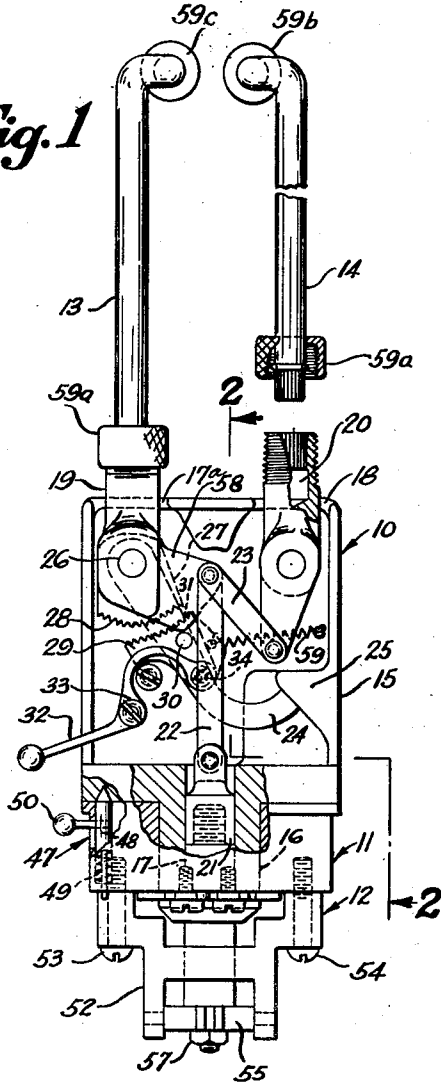


Fig. 3

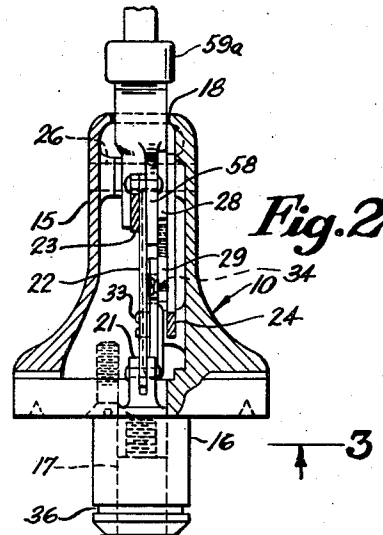


Fig. 2

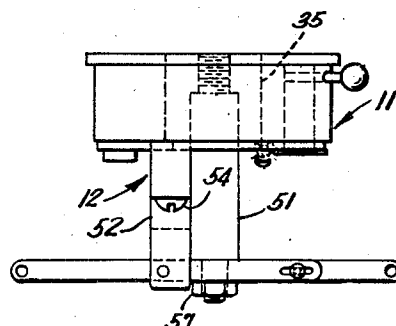


Fig. 4

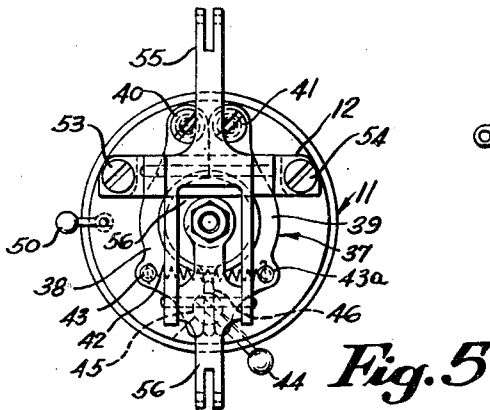


Fig. 5

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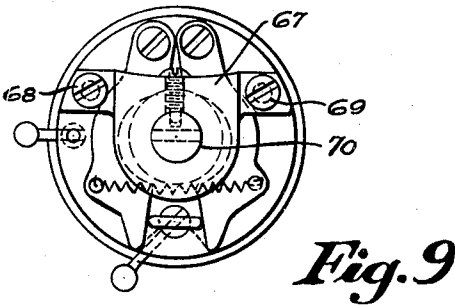
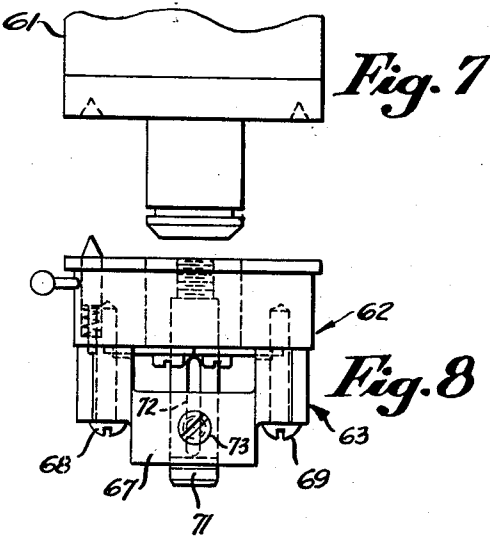
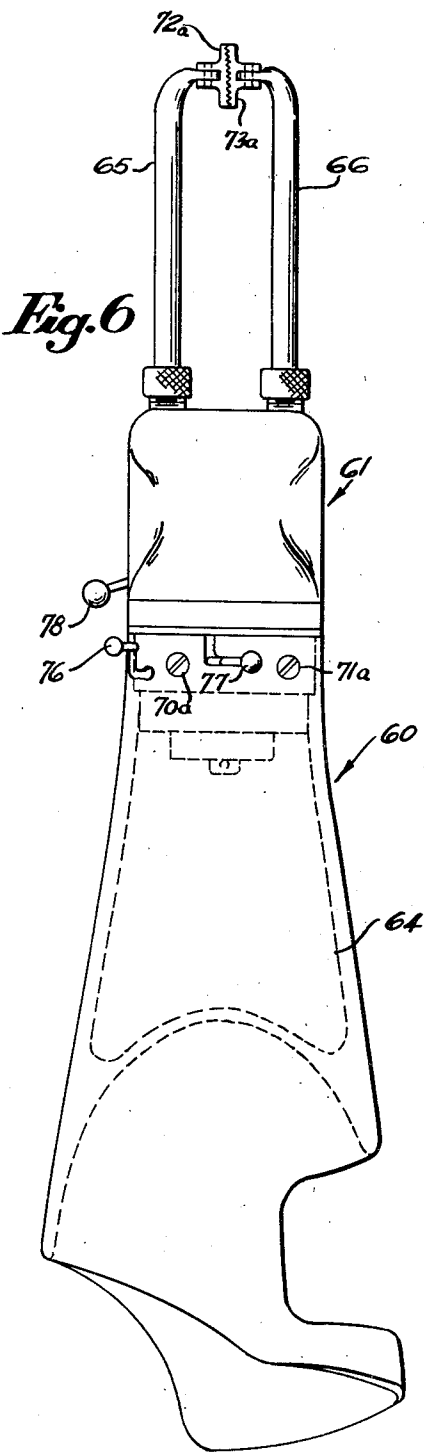
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Fig. 17 *Fig. 16*

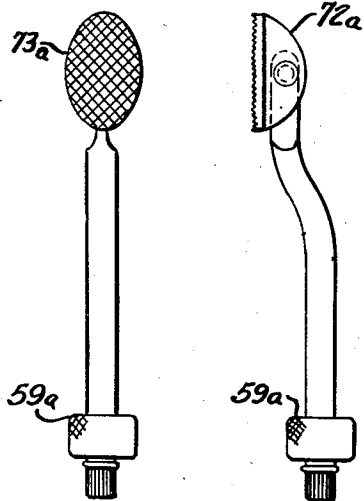


Fig. 14 *Fig. 13*

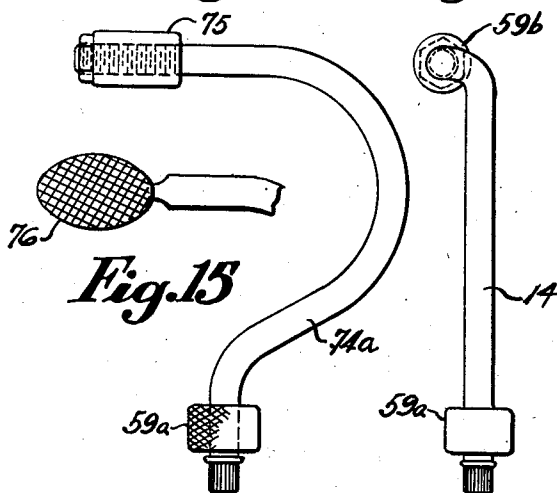


Fig. 15



Fig. 18

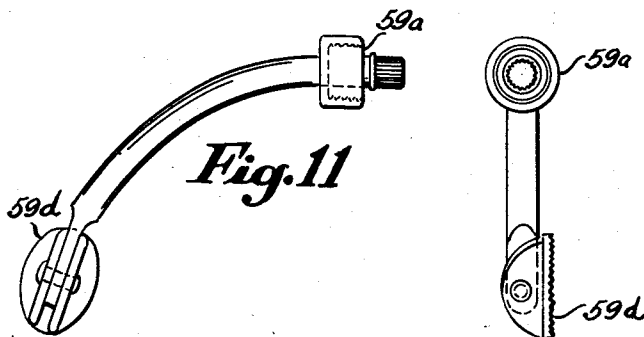


Fig. 10

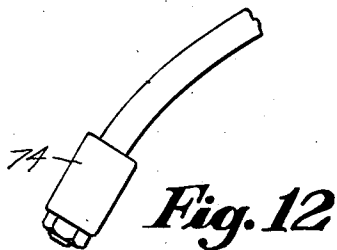


Fig. 12

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ARTIFICIAL ARM

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6 Claims. (Cl. 3—12)

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This invention relates to artificial arms adapted to replace an amputated upper limb of man.

It is an object of the instant invention to provide an efficient and effective artificial arm where the amputation has been made either below or above the elbow.

A further object is to provide an artificial arm having wide range of adaptation.

Another object is the provision of an artificial arm in which the attaching, adjusting, and removal means is both simple and effective.

Other objects of the instant invention will become apparent in the course of the following specification.

In the accomplishment of these objectives, the artificial arm is made in two embodiments, one for the case of an amputation below the elbow and the other for the case of an amputation above the elbow. In both embodiments, there are similar interchangeable finger members, a palm member which supports the finger members and houses the mechanism for the operation thereof, and a wrist member supporting the palm member in any desired position of the finger members. The grasping and releasing of an object by the finger members and the twisting of the palm member relative to the wrist member have a range beyond that of the natural hand and with a substantial approach to reality. In the case of the first embodiment, that is an artificial arm designed to replace an amputated portion of the upper limb where the amputation has been made below the elbow, the attachment between the stump of the limb and the wrist member is equipped with a system of levers designed to be operated by the body of the man in a known manner and which actuates the finger members when grasping and releasing an object. In the second embodiment of the artificial arm, that is one for the case where the amputation has been made above the elbow, the finger members, the palm member, and the wrist member are the same as in the first embodiment. However, the attaching member between the wrist member and the stump of the arm differs in form, is without a leverage system, and is supplied with a forearm member attached at the bottom to the wrist member and at the top fitted over the arm stump and shoulder of the man. The finger members are actuated by members between the free ends of the actuating mechanism of the finger members and the body of the man.

The invention will appear more clearly from the following detailed description when taken in connection with the accompanying drawings

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showing by way of example a preferred embodiment of the inventive idea.

In the drawings:

Figures 1 through 5 show the first embodiment of the artificial arm designed to replace the amputated portion of the upper limb where the amputation has been made below the elbow and in which:

Figure 1 is a top view of the artificial arm assembled with the finger, palm and wrist members, and the attaching member for securing the artificial arm to the stump of the amputated arm, part of the surface portion of the artificial arm being broken away to show the mechanism, and constructed in accordance with the principles of this invention.

Figure 2 is a sectional view taken on line 2—2 of Figure 1.

Figure 3 is a sectional view taken on line 3—3 of Figure 2.

Figure 4 is a side view of the attaching member releasably securing the lower portion of the artificial arm to the stump of the amputated arm.

Figure 5 is an end view of the attaching member shown in Figure 4.

Figures 6 through 8 show the second embodiment of the artificial arm, designed for cases where the amputation has been made above the elbow, and in which:

Figure 6 is a top view of the artificial arm with the forearm member in position.

Figure 7 is a fragmentary top view of the wrist member of the artificial arm shown in Figure 6 with the forearm member removed.

Figure 8 is a top view of the attaching member for releasably securing the lower portion of the artificial arm to the stump of the amputated arm and with the forearm member removed.

Figure 9 is an end view of the attaching mechanism shown in Figure 8.

Figures 10 through 18 show various interchangeable finger members for use with both embodiments of the artificial arms and in which:

Figure 10 is a top view of one finger member equipped with a hingedly mounted and knurled type finger tip.

Figure 11 is an end view of the mechanical finger shown in Figure 10.

Figure 12 is a fragmentary end view of the finger member shown in Figure 10 but provided with a rubber finger tip.

Figure 13 is a top view of the finger member

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shown in Figure 1 and equipped with a rubber finger tip.

Figure 14 is a side view of the mechanical finger shown in Figure 13.

Figure 15 is a fragmentary side view of the finger member shown in Figure 13 but equipped with a knurled type finger tip.

Figure 16 is a top view of the finger member shown in Figure 6, the finger member being equipped with a hingedly mounted knurled type finger tip.

Figure 17 is a side view of the finger member shown in Figure 16.

Figure 18 is a fragmentary top view of the finger member shown in Figure 16 but equipped with a rubber finger tip.

Referring now in greater detail to the first embodiment of the artificial arm shown in Figures 1 through 5, that is the artificial arm designed for cases where the amputation has been made below the elbow, reference numeral 10 indicates the palm member, 11 the wrist member, 12 the attaching member for securing the wrist member to the stump of the amputated arm, 13 one of the finger members, and 14 the other finger member.

The mechanical palm 10 is constituted of a housing 15 as shown in Figures 1 and 2, the housing 15 having a finger end and a wrist end. At the wrist end of the housing 15 and along the longitudinal center line thereof is a cylindrical projection 16 which may be formed integral therewith. A cylindrical opening 17 is formed along the common center lines of the cylindrical projection 16 and housing 15 which opening communicates with the interior of the housing 15. Also on the wrist end of the housing 15, as shown in Figure 3, are a series of spaced openings 21 for releasably locking the palm member 10 in any desired position relative to the wrist member 11 as later described. At the finger end of the housing 15 are two openings 17^a and 18 for the insertion of the finger stubs 19 and 20, respectively, and described infra.

Pivotally mounted within the housing 15 of the mechanical palm member 10 and protruding through the openings 17^a and 18 are the substantially hollow finger stubs 19 and 20, respectively, the diameter of the finger stubs being sufficiently less than the diameter of the openings 17 and 18 to permit reasonable rotation therein. Any known pivotal mounting means may be used and a suitable support may consist of a protuberance raised on the inner surface portion of the housing 15. The protruding hollow cylindrical end of each finger stub 19 and 20 is threaded on the outside while the inside is serrated as shown in Figure 1 for the releasable attachment of the mechanical fingers 13 and 14 described later. The finger stubs 19 and 20 are rotated toward and away from each other by the following mechanism: Longitudinally slidable within the opening 17 in the cylindrical projection 16 of the mechanical wrist 11 is a plunger 21, the free end of which is internally threaded as shown in Figures 1 and 2. On the opposite end of the plunger 21 is a pivotally connected link 22, the opposite end of the link 22 being pivotally connected to the power arm of the finger stub 20 by a second link 23 so that an inward longitudinal movement of the plunger 21 will rotate the threaded end of the finger stub 20 outwardly and the outward longitudinal movement of the plunger 21 will rotate the threaded end of the finger stub 20 inwardly.

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The finger stub 19 is adapted to be rotated simultaneously toward and away from the previously described finger stub 20 in the following manner: The bottom of the finger stub 19 flares downwardly and inwardly to provide a relatively flat surface portion 58 (Fig. 1) the end of which is also pivotally connected to the pivotally connected ends of the links 22 and 23 so that any longitudinal movement of the plunger 21 imparts a coacting movement in both finger stubs 19 and 20 whereby the grasping and releasing of an object by the finger members 13 and 14 is attained.

Where the weight or surface characteristics of the object to be grasped requires or for other reasons, the mechanical fingers 13 and 14 may be releasably locked in any desired position relative to each other by the following mechanism: An arm 24 (Fig. 1) is inserted below the power arm of the finger stub 19 and secured thereto by the pivot pin 25 so that as the finger stub 19 is rotated by the previously described mechanism the inwardly extended end of the lever 24 will slide along the periphery of an inwardly directed angular protuberance 25 (Fig. 1) which may be formed integral with the housing 15 or otherwise. Between the lever 24 and the power arm of the finger stub 19 and designed to be rotated therewith is an inwardly directed plate 27 along the inwardly directed edge of which are a plurality of teeth 28. Coacting with the teeth 28 of the plate 27 is a second plate 29 pivotally mounted by any known means 30 to the arm 24 and along the outwardly directed edge of which (Fig. 1) are a plurality of teeth 31. The engagement of the teeth 31 of the second plate 29 or the locking and unlocking of the finger stubs 19 and 20 is controlled by a handle member 32 which protrudes through a longitudinally formed slot in the housing 15 and is pivotally attached to the inside surface portion of the housing 15 by any suitable means 33 and the opposite end of which is pivotally secured to the arm 24 by any pivotal mounting means 34 so positioned that as the handle member 32 is moved toward the finger stubs 19 and 20, the teeth 31 of the second plate 24 are brought into engagement with the teeth 28 of the plate 27 which through the previously described linkage system locks the stubs 18 and 19 in any desired position. Between the second plate 29 and the inner surface of the housing 15 is a spring member 59 so positioned on the second plate 29 that the same will aid in maintaining the coacting teeth of the plates disengaged except when locked together by the previously described handle member 32.

The wrist member 11 as shown in Figures 1, 4, and 5 is a cylindrical member having a diameter approximately equal to the diameter of the wrist end of the aforementioned palm member 10 with which it is assembled. Along the axis of the wrist member 11 is a cylindrical opening 35 (Fig. 4) designed for the releasable insertion of the cylindrical projection 16 on the wrist end of the palm member 10, the end of the projection being provided with a circumferential recess 36 (Fig. 2) which coacts with the subsequently described jaw members 38 and 39 for the rotation and releasable insertion of the projection 16 in the opening 35 of the wrist member 11. The jaw members 38 and 39 are pivotally secured at one end in the free end of the mechanical wrist 11 by any pivotal mounting means 40 and 41, respectively, the plane of the jaw members being perpendicular to a plane through the axis of the

wrist member 11, the jaw members further having a thickness less than the width of the recess 36 with which said members coact. At the free ends of the jaw members 38 and 39 is a spring member 42 secured under tension by any suitable means 43 and 43^a disposed on the respective jaw members to maintain the same together under tension. The manipulation of the jaw members 38 and 39 when, for example, desiring to release the projection 16 of the mechanical palm 10 from the mechanical wrist 11 is accomplished with a handle member 44 protruding through a circumferential slot in the side wall of the mechanical wrist member 11, the opposite end of the handle member 44 being pivotally connected to the wrist member 11 by any known means 45 which is attached as desired to a cam member 46 (Fig. 5). The ends of the jaw members 38 and 39 may be cut away along the vertical center line of the wrist member 11 (Fig. 5) to permit the cam member 46 to be inserted between the opposed ends thereof while the pivotal mounting means 45 may be countersunk.

In the palm end of the wrist member 11 is a releasable locking mechanism 47 (Fig. 1) which is inserted in an opening formed in the wrist member 11 along the circumference of a circle with center on the axial center of the wrist member 11 and having a diameter equal to the diameter of a circle passing through the centers of the openings 21 (Fig. 3) in the wrist end of the palm member 10 centered on the axis thereof and previously described. The locking mechanism 47 is formed with a cylindrical body 48, the free end of which may be in the shape of an inverted cone slidably inserted in the aforementioned opening in the palm end of the wrist member 11. The top of the cylindrical body 48 may be of reduced diameter for the insertion of the spring member 49 therearound so that as the cylindrical body 48 is moved upwardly against the tension of the spring 49 by a handle member 50 protruding through a longitudinal slot in the side wall of the mechanical wrist 11, the tendency of the cylindrical body 48 will be to automatically return to a position where the inverted conical end will protrude beyond the plane of the palm end of the mechanical wrist 11 for releasably maintaining the finger carrying palm member 10 in any desired position of the finger members 13 and 14 relative to the wrist member 11.

The means for rotating the mechanical fingers 13 and 14 toward and away from each other simulative of grasping with the fingers of the hand has been previously described in connection with the palm member 10. The means for imparting the grasping and releasing motion to the finger members 13 and 14 through the wrist member 11 and attaching member 12 is as follows: A cylindrical link 51 (Fig. 4) is slidably passed through the cylindrical opening 25 (Fig. 4) of the wrist member 11 and thence through the aligned opening 17 (Fig. 2) in the cylindrical projection 16 of the palm member 10. The link 51 is threaded on the inserted end as shown in Figure 4 for engagement with the coacting tap in the end of the plunger 21 (Fig. 1) so that any longitudinal movement of the cylindrical link 51 is imparted to the plunger 21 and thence to the finger stubs 19 and 20 in the manner previously described.

The attachment member 12 for securing the artificial arm 10 to the end of the amputated arm is constituted of a frame 52 (Fig. 1) releasably secured on the free end of the wrist member

11 by the screws 53 and 54 (Figs. 1 and 5). Pivotally mounted between two spaced parallel members at the top of the frame 52 is a lever 55. The lever 55 is a U-shaped member as shown in Figure 5 and between the U-shaped portions of which is pivotally mounted a second lever 56. Along the axis of the wrist member 11 extended to intersect the second lever 56 an opening is made for the insertion of the free and threaded end of the cylindrical link 51 which is passed therethrough and releasably secured to the second lever 56 by a nut 57 (Figs. 1 and 4), the threaded end of the link 51 being of reduced diameter. Thus, any movement of the levers 55 and 56 will be imparted through the linkage chain to the finger stubs 19 and 20.

The mechanical fingers 13 and 14 are made of any suitable material and in the shape best suited to the needs of the particular individual. At one end, that is the bottom, the finger members are serrated so that when slid into the coating inside serrated surface portions of the finger stubs 19 and 20, any rotary movement thereof is prevented and especially when the nut 59^a is threaded on the end of the finger stubs 19 and 20, a flange being formed at the bottom of the serrated portion. The finger tips 59^b and 59^c (Fig. 1) may be made of rubber where the surface of the objects being handled have an appropriate surface for handling with rubber. On the other hand, as shown in Figures 10 and 11, the finger tips 59^d may be formed with hinged finger tips with knurled coating surface portions for handling articles adapted thereto. Of course, depending upon the object to be handled the central portion of the finger members may be of the shape shown in Figures 10, 11, and 12, or the like.

The operation of the first embodiment of the artificial arm 10 as shown by Figures 1 through 5 is as follows:

Assume that the artificial arm 10 is disassembled and that the problem is to provide an artificial arm where the arm has been amputated below the elbow. The case may be studied to determine the most suitable shape of mechanical fingers to be furnished, perhaps with rubber finger tips as shown in Figures 1, 12, 13, 14, and 18. While the procedure may be varied, suppose the connecting member 12 is secured to the end of the amputated arm with the levers 55 and 56 protruding and free to be actuated. The handle member 44 on the wrist member 11 is moved to a position wherein by virtue of the cam 46 the jaw members 38 and 39 are forced apart against the tension of the spring 42. The cylindrical projection 16 of the palm member 10 is then inserted in the cylindrical opening 35 until the recess 36 is about in the plane of the jaw members 38 and 39 whereupon the handle member 44 is moved to the opposite position or where the jaw members 38 and 39 are in the recess 36 which permits rotation of the palm member 10 relative to the wrist member 11 except for the action of the releasable locking mechanism 47 (Fig. 1). Further study of the individual case may lead to the conclusion that the most convenient grasping position is that shown in Figure 1 and if not in that position, the handle 50 is moved upwardly against the action of the spring 49 which permits the palm member 10 to be rotated as desired, the jaw members 38 and 39, it will be remembered, having been inserted in the recess 36. The finger members 13 and 14 having been previously selected for the object to be handled and the relative position of the man in respect to the ob-

ject having been determined, it remains only to provide a means for imparting longitudinal movement to the cylindrical link 51, upwardly when grasping the object and downwardly when releasing the same. This is accomplished with rigid members (not shown) secured between the ends of the levers 55 and 56 and that part of the shoulder or part of the arm that will be called upon to provide the movement and which is in accordance with known practice. Suppose further, that the object to be grasped is relatively heavy and the danger of slipping imminent through the inadvertent movement of the actuating mechanism of the artificial arm, then by moving the handle member 32 downwardly the coacting teeth 31 and 28 mesh locking the finger members 13 and 14 securely with the object grasped therebetween until first unlocked by moving the handle member 32 in the opposite direction so that the teeth 31 and 28 are disengaged and then imparting a downward movement on the cylindrical link 51 by the inward movement of the ends of the power arms of the levers 55 and 56 forcing the finger tips 59^b and 59^c out of engagement with the object.

In the second embodiment of the artificial arm, that is for cases where the amputation has been made above the elbow, and shown in Figures 6 through 9, reference numeral 60 indicates the artificial arm, 61 the palm member, 62 the wrist member, 63 the attaching member, 64 the forearm member, 65 one of the finger members, and 66 the other finger member.

The palm member 61 and the wrist member 62 are similar to corresponding members of the first embodiment and previously described.

The attaching member 63 is constituted of a frame 67 secured to the free end of the wrist member 62 by the screws 68 and 69. The frame 67 protrudes above the plane of the end of the wrist member 62 and extends over the central portion thereof. Along the axis of the wrist member 62 extended is a cylindrical opening 70 in the frame 67 through which is slidably inserted a cylindrical link 71 which has a recess 72 extending longitudinally therealong. Through the frame 67 a screw 73 is threaded which protrudes into the recess 72 so that irrespective of any force applied to the link 71 it is prevented from rotating.

The forearm member 64 is made of any suitable material and is designed to be fitted over the remaining portion of the amputated arm and up over the shoulder. At one end, the forearm member 64 is releasably attached around the wrist member 62 by any suitable fasteners 70^a and 71^a. Slots, of course, are provided in the respective members for the movement of the handle members, 76, 77, and 78.

The operation of the artificial arm of the second embodiment is as follows:

The mechanical fingers 65 and 66 (Figs. 16 and 17) are selected in accordance with the task to be performed. For example, it may be decided to select the finger members having the hinged mounted knurled tips 72^a and 73^a as shown and in which case the finger tips 72^a and 73^a readily adjust themselves to the surface of the object. Or it may be decided to use fingers similar to 65 and 66 in form but provided with a rubber tip 74 as shown in Figure 18. If the nature of the object warrants, finger members 74^a (Fig. 14) each provided with a rubber finger tip 75 may be used or the same shaped finger may be used with a knurled finger tip 76 (Fig. 15). The man-

ner of attaching the finger member has been described in the first embodiment and also the manner of attaching the cylindrical projection on the palm end of the wrist member. The forearm member 64 may first be secured over the forearm and shoulder and then attached to the wrist member 62 with the screws 70^a and 71^a. The handle member 76 may be pulled upwardly whereby the palm member 62 is rotated to a selected position relative to the wrist member 62 and then the handle member 76 released to lock the members in the selected position as described in the first embodiment. The palm member 61 may then be inserted in the wrist member 62 by movement of the handle member 77 also in the manner of the first embodiment. Rigid members are then run from the body muscles (not shown) for actuating the finger members to the free end of the cylindrical link 71 and under the forearm member 64 to impart the movement of the muscles of the body to the finger members 65 and 66 which may be releasably locked in any position by working the lever 78 in the manner described in the first embodiment.

It is apparent that the specific illustrations shown above have been given by way of illustration and not by way of limitation and that the structures above described are subject to wide variation and modification without departing from the scope or intent of the invention. All of such variations and modifications are to be included within the scope of the present invention.

What is claimed is:

1. An artificial hand comprising a hollow palm member with open end, two hollow finger stubs for the palm member, means pivotally mounting the finger stubs intermediate the ends thereof in the palm member and with the weight arms protruding therefrom, the finger stubs being in spaced relationship and operable in the same plane, the power arm of one finger stub terminating in an inwardly directed plate, the protruding ends of the finger stubs being externally threaded and the inner surfaces longitudinally serrated, a removable finger member for the threaded end of each stub, finger stub actuating means for the wrist member, said means comprising a longitudinally displaceable link disposed in the palm member intermediate the finger stubs, means pivotally connecting the link to the plate of the finger stub, a second link pivotally disposed between the power arm of the other finger stub and the pivotal mounting means of the plate and first link, and means releasably locking the finger stubs in any desired position coacting with the finger stub actuating means.

2. An artificial hand according to claim 1 in which the means releasably locking the finger stubs in any desired position coacting with the finger stub actuating means comprises a lever arm pivotally disposed in the wrist member, one end of the arm being secured to the finger stub plate, the free end of the arm curving inwardly toward the opposite side of the palm member, a guide disposed in the palm member and coacting with the free end of the arm, another plate disposed on the finger stub plate, one edge of the other plate being inwardly directed and of arcuate form and having spaced teeth formed thereon, a second plate pivotally disposed on the lever arm, one edge of the second plate having teeth formed thereon coacting with the teeth of the first plate, means automatically maintaining the first and second plates in spaced relationship, and

means releasably bringing the teeth of the second plate into operable engagement with the teeth of the first plate.

3. An artificial hand according to claim 1 in which each finger member comprises a body 5 portion, one end of the body portion being serrated and coacting with the internally serrated surface of the finger stub, means removably securing the serrated end of the body to the threaded end of the stub, and a knurled finger 10 tip hingedly disposed at the opposite end of the body.

4. An artificial hand according to claim 3 in which each finger member is characterized by having a rubber finger tip removably disposed on 15 the free end thereof.

5. In an artificial hand having a hollow palm member, said palm member having a longitudinally disposed link, finger members protruding from one end of the palm member, the opposite end of the palm member having a protrusion of circular cross section with a circumferential groove adjacent the free end and a central longitudinal opening aligned with said longitudinally disposed link in the palm member, the end of the 20 palm member with the protrusion having circumferentially spaced openings adjacent the protrusion; a wrist member for the end of the palm member with the protrusion, the wrist member having a recess coacting with the protrusion on 30 the palm member, a plunger reciprocal in the opening in the protrusion, means securing one end of the plunger to the longitudinally disposed link in the palm member, the opposite end of the plunger having an internally threaded recess, 35 means releasably securing the protrusion of the palm member in the wrist member, said means comprising a pair of jaw members pivotally disposed in the free end of the wrist member and coacting with the circumferential groove in the 40 protrusion of the palm member, spring means between the free ends of the jaw members maintaining said jaws under tension in the groove, and cam means between the free ends of the jaw

members releasing said members from the groove; and means releasably locking the palm member in any position relative to the wrist member, said means comprising a cylindrical body slidably disposed under outwardly directed tension in the rim of the wrist member and coacting with the circumferentially spaced openings in the end of the wrist member having the protrusion, and means releasing the cylindrical body from the opening.

6. In an artificial hand having a wrist member with a central longitudinal opening and a plunger with a threaded recess in one end reciprocal in the opening, the opposite end of the plunger being in operable engagement with the finger actuating mechanism; a stump support for the wrist member, the support comprising a frame, means releasably securing one end of the frame to the free end of the wrist member, the frame having an opening aligned with the opening in the wrist member, a link reciprocal in the opening, one end of the link being threaded and coacting with the threaded recess in the plunger, a U-shaped lever pivotally disposed in the free end of the frame, a second U-shaped lever pivotally disposed in the free ends of the first, and means releasably securing the free end of the link to the second lever.

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