

Sept. 23, 1947.

J. OTTERMAN

2,427,974

ARTIFICIAL ARM

Filed April 16, 1946

5 Sheets-Sheet 1

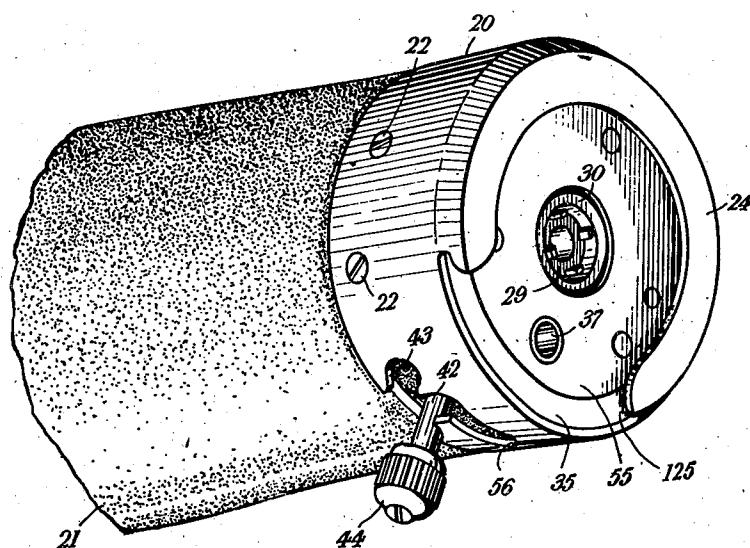


Fig. 1.

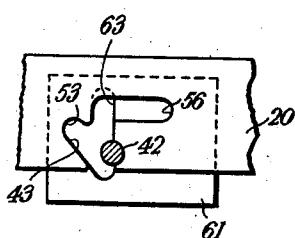


Fig. 6.

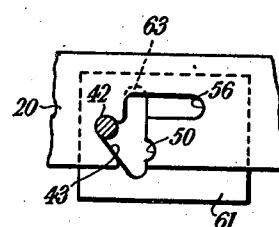


Fig. 7.

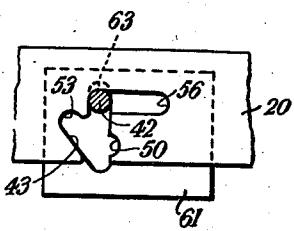


Fig. 8.

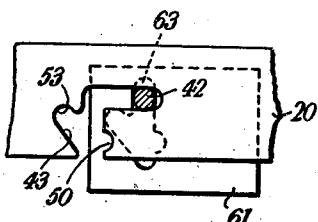


Fig. 9.
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ARTIFICIAL ARM

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5 Sheets-Sheet 2

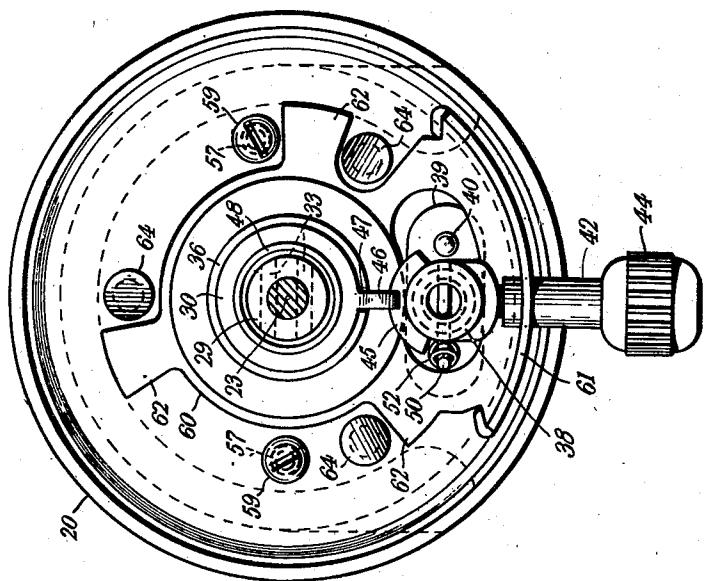


Fig. 3.

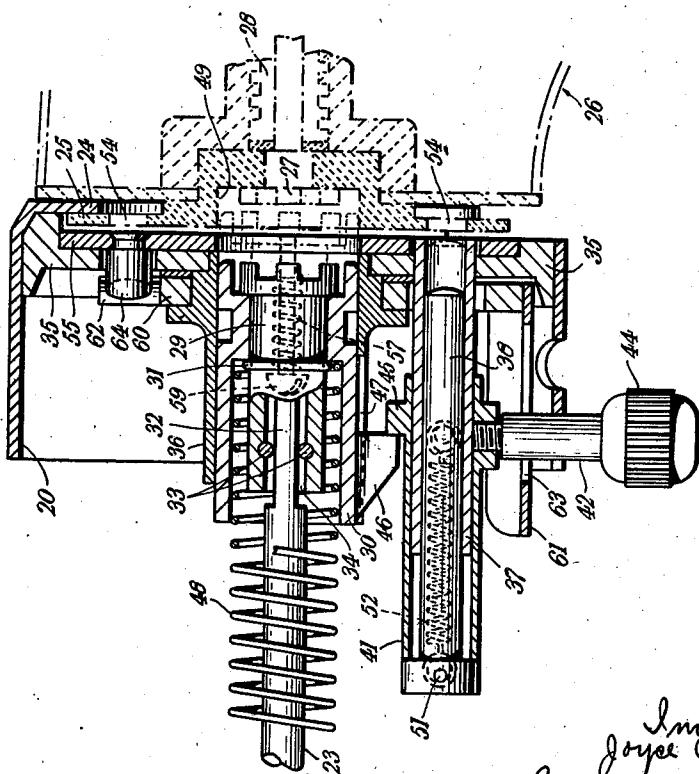


Fig. 2.

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5 Sheets-Sheet 3

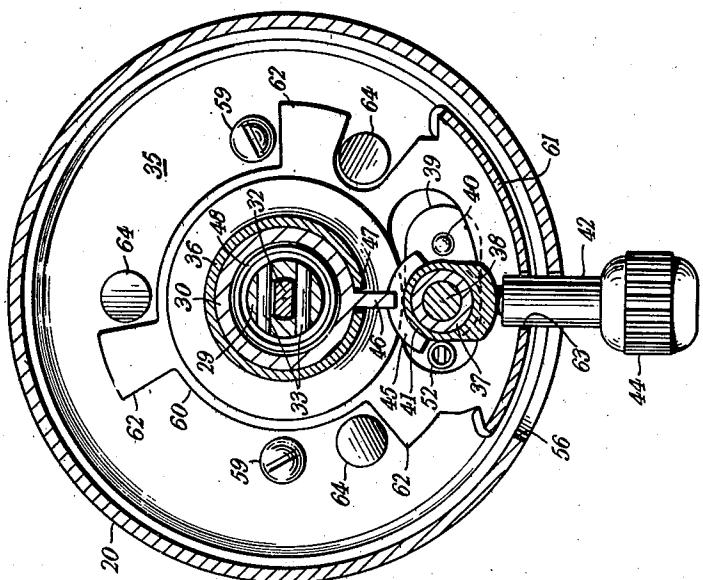


Fig. 5.

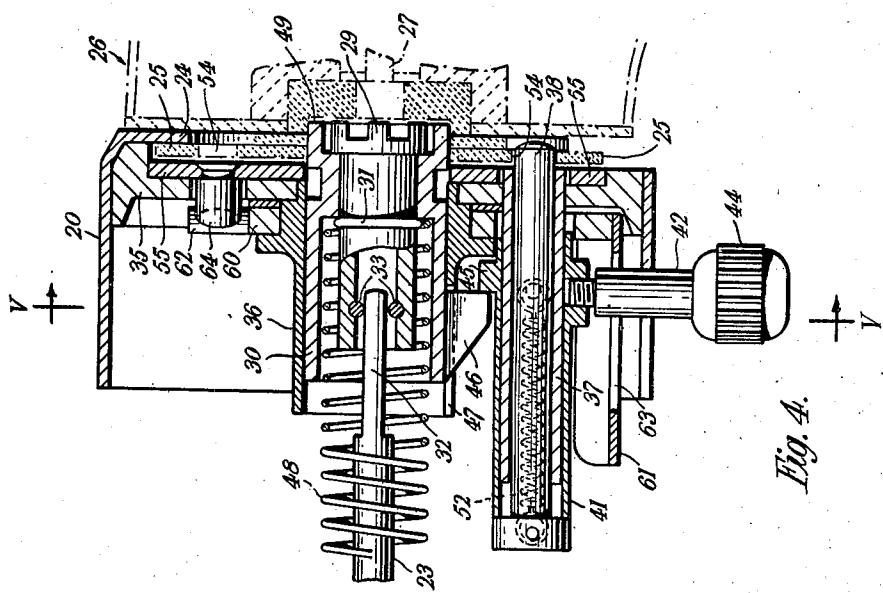


Fig. 4.

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ARTIFICIAL ARM

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5 Sheets-Sheet 4

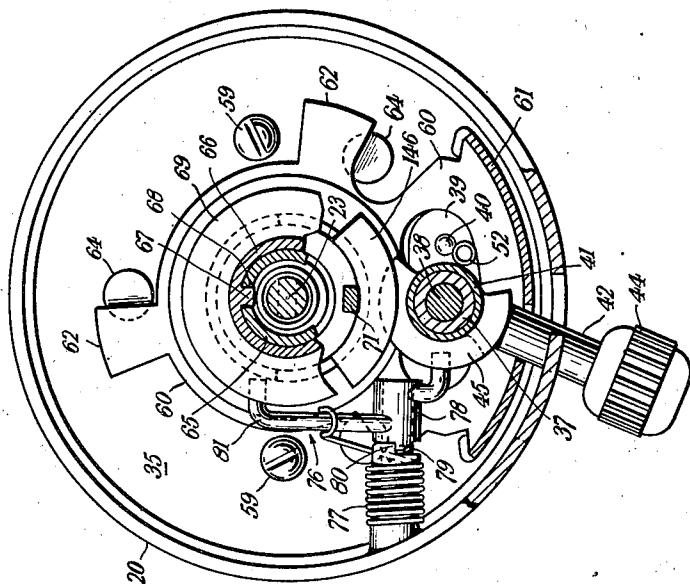


Fig. II.

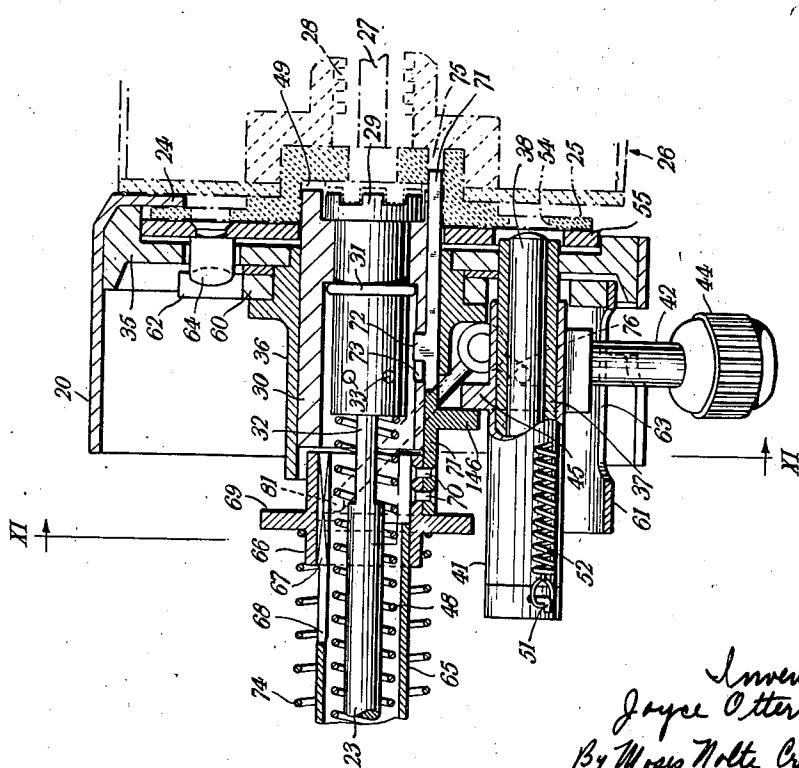


Fig. 10.

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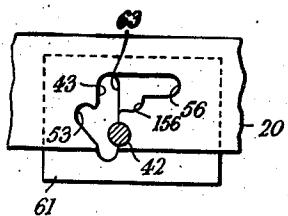


Fig. 12.

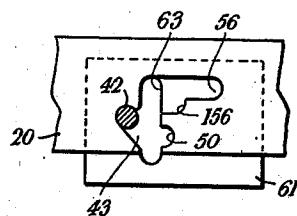


Fig. 13.

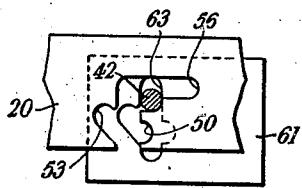


Fig. 14.

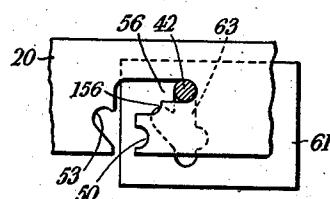


Fig. 15.

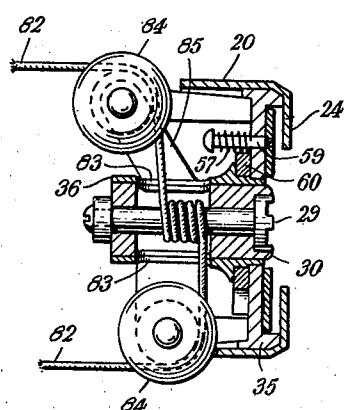


Fig. 16.

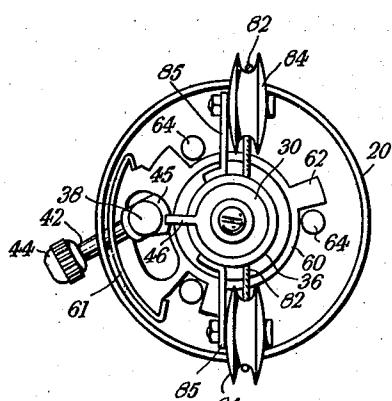


Fig. 17.

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UNITED STATES PATENT OFFICE

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ARTIFICIAL ARM

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Application April 16, 1946, Serial No. 662,650
In Great Britain September 28, 1945

14 Claims. (Cl. 3—12)

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This invention relates to artificial arms and has for its object to provide mechanism whereby an artificial hand or other appliance may be rapidly coupled to or detached from the arm without the use of the other hand. The invention is thus of particular value in cases of double amputation, since it enables the user of the arm to replace rapidly and conveniently an artificial hand by some other appliance, e. g. a screw driver, split hook or the like.

Artificial arms, as is well known, commonly include a driving member by which the user can operate a hand or the like by traction on a flexion cord, wire or the like, which is normally operated by movement of the shoulders, chest or foot. It is necessary therefore that attachment of the hand or the like to the arm should be effective to couple the hand to the driving member for operation thereby.

The invention provides an artificial arm, having a wrist fitting comprising an inturned flange at its outer end and having a lateral opening to permit a base plate of an artificial hand or the like to be slid edgewise into position beneath the flange, a drive member displaceably mounted in the wrist fitting, a locking bolt likewise displaceably mounted in the wrist fitting, and an operating member coupled to and serving to control the positions of the drive member and the locking bolt, said operating member projecting from the wrist fitting and being movable between a position in which the drive member and locking bolt are retracted, so as to permit of insertion of the base plate into or removal thereof from the wrist fitting, and a position in which the drive member and locking bolt are projected so as respectively to be in driving engagement with the hand or the like and to lock the same against rotation in relation to the wrist fitting.

The wrist fitting may include a member operable, on movement of the operating member to an intermediate position, to engage a central recess in the base plate to hold the same against rotation in relation to the wrist fitting, said member coming into operation prior to projection of the locking bolt.

In a preferred construction according to the invention, the wrist fitting carries a barrel mounted for axial sliding movement in relation thereto between a retracted and a projected position, said barrel containing the drive member for imparting operating movement to the hand or the like and said barrel serving, when but only when in the projected position, to engage a hole in the base plate to prevent with-

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drawal thereof from the wrist fitting, and the operating member is movable, by pressure thereon, from a first position through a second position to a third position and back again to the first position, said operating member being so operatively connected to the barrel and to the locking bolt that in its first position the barrel and locking bolt are both retracted, in its second position the barrel is projected and the locking bolt not yet moved to the locking position, while in its third position the barrel is further projected to couple the drive member to the hand or the like and the locking bolt is projected to locking position.

15 When the wearer wishes to pick up the hand therefore he has merely to lower the arm over the hand, while the latter is lying on a table or other support, so as to engage the base plate beneath the flange, then to press on the operating

20 member to bring it to its second position in which the barrel is projected and the hand held against removal, and finally to press on the operating member to bring it to its third position in which the driving member is coupled to the hand and the locking bolt engages the base plate to prevent rotation thereof in relation to the wrist fitting. The hand can of course be rotated in relation to the arm so long as the locking bolt is retracted, and despite initial projection of the 30 barrel.

To uncouple the hand, the reverse procedure is adopted, the wearer pressing the operating member against the table so as to return it to its first position when, if the arm is held to rest the 35 finger tips on the table, the weight of the hand will cause it to drop out of the wrist fitting.

In order to prevent wobbling or chattering of the hand in relation to the wrist fitting, I prefer to provide in the wrist fitting a pressure plate 40 which, in the first and second positions of the operating member is in a free position but which, after the operating member has moved to its third position to engage the locking bolt with the base plate, moves into position to press the base plate firmly into engagement with the flange on the wrist fitting.

The driving member may be constituted by a push rod arranged to receive reciprocating movement from the flexion cord through a suitable lever action. It is preferred, however, to employ a rotary driving member, which will enable a hand of the construction described in E. W. Hobbs' U. S. application Serial No. 644,498 to be utilised in conjunction with the wrist mechanism the subject of the present invention. Also the

use of a rotary driving member is of particular value when a screwdriver appliance is substituted for the hand.

Rotary movement may be imparted to the driving member in the case of above elbow amputation by the mechanism described in my copending United States application Serial No. 646,133, and in the case of below elbow amputation by the mechanism described in my British patent application No. 53/46. Alternatively, in the case of below elbow amputation, the rotary movement may be applied by means of a double ended cord wound around the driving member, traction on one end of the cord by shoulder movement rotating the driving member in one direction and traction on the other end of the cord by chest movement rotating the driving member in the reverse direction.

Some practical forms of artificial arm according to the invention will now be described in further detail, by way of example with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view of one form of wrist mechanism according to the invention, suitable for cases of above elbow amputation,

Fig. 2 is a cross section on a larger scale through the wrist mechanism with the parts in the position they occupy with the operating member in its first position;

Fig. 3 is an elevation looking from the left hand side of Fig. 2;

Fig. 4 is a view similar to Fig. 2, but with the parts in the position they occupy with the operating member in its third position;

Fig. 5 is a section on the line V—V in Fig. 4;

Figs. 6-9 are scrap development views, on a reduced scale, of the wrist mechanism as seen from the under side of Fig. 2 and Fig. 4, showing alternative positions of the operating member;

Fig. 10 is a cross section through an alternative form of wrist mechanism, generally similar to that of Figs. 1-9, but in which provision is made for pronation and supination of the hand;

Fig. 11 is a section on the line XI—XI in Fig. 10;

Figs. 12-15 are views, corresponding to Figs. 6-9, of this second embodiment;

Fig. 16 is a cross section through another form of wrist mechanism suitable for below elbow amputation, and

Fig. 17 is an elevation looking from the left hand side of Fig. 16.

Like reference characters indicate like parts throughout the figures.

Referring first of all to the embodiment shown in Figs. 1-9, the wrist fitting comprises a metal sleeve 20 fixed, by screws 22, to the lower end of the forearm unit 21 of an artificial arm of the kind described in United States application Serial No. 646,133. Within the forearm unit is disposed a rotary drive shaft 23 for imparting rotary driving movement to a hand or the like to be fitted to the wrist mechanism as later described.

At its outer end the sleeve 20 is formed with an inturned flange 24 and with an opening 125 to permit of edgewise insertion into position beneath the flange of the base plate 25 (Fig. 2) of an artificial hand 26. This hand is of the construction described in United States application Serial No. 644,498, and comprises a screw 28 arranged to impart opening and closing movement to the fingers when rotated by engagement between a driver 27 fixed to the screw and a driving member 29 carried by the shaft 23. It will be appre-

ciated, however, that for the hand may be substituted any other appliance, e. g. a screw driver, a split hook or the like, having a base plate such as 25 and a screw and driver, such as 28, 27 for imparting operating movement thereto.

The driving member 29 is mounted within a barrel 30, so as to be free to rotate in the barrel. A spring clip 31 holds the driving member 29 against axial movement in relation to the barrel.

10 The driving member 29 is coupled to the shaft 23 so as to rotate therewith by the coupling shown in Figs. 2 and 4. A flat 32 on the end of the shaft 23 engages between a pair of transverse pins 33 fitted in the hollow end 34 of the driving member 29. A similar coupling is provided at the upper or elbow end of the shaft 23 and these two couplings permit, as described in United States application Serial No. 646,133, of effective transmission of the drive from the elbow to the driving member 29 even though the couplings may be brought somewhat out of alignment, e. g. as the result of bending of the forearm skeleton structure when carrying a heavy weight.

Inside the wrist fitting is fitted an end plate 35 to which is attached a sleeve 36 housing the barrel 30 and also a tubular guide member 37 for a locking bolt 38. The guide member 37 (Fig. 5) has outwardly projecting lugs 39 which are secured to the end plate 35 by rivets, one of which is shown at 40. Surrounding the guide member 37 is a sleeve 41, to which is fixed an operating lever 42 which extends through a slot 43 in the sleeve 20 and carries a knob 44 by means of which the wrist mechanism is manipulated, either by use of the other hand or by pressing the knob 44 against a table or other surface.

The sleeve 41 carries a projection 45 which cooperates with a projection 46 on the barrel 30, which projection 46 extends through a slot 47 in the sleeve 36. A spring 48 which abuts at its left hand end (Fig. 2) against a collar (not shown) on the shaft 23 tends to urge the barrel 30 outwards into a central recess 49 in the base plate 25 to engage the driving member 29 with

40 the driver 27. When, however, the operating lever 42 is in its first or inmost position in the slot 43, shown in Figs. 2 and 6, in which it can be retained by moving it laterally into a recess 50 in the slot, the barrel 30 and driving member 29 are held retracted, as shown in Fig. 2, by engagement of the projections 45, 46. The locking bolt 38 is also held retracted. The bolt 38 carries at its inner end a pin 51 (Fig. 3) which constitutes an anchorage for a spring 52, fixed at its other end to a similar pin projecting from the sleeve 41. The axial position of the bolt 38 is thus also dependent on the position of the lever 42 in its slot 43.

In the position of the parts shown in Fig. 2 therefore the base plate 25 can be engaged with or disengaged from the wrist mechanism. Assuming the wearer wishes to pick up the hand, he moves the control lever to the position of Figs. 2 and 6 and lowers the wrist fitting over the hand, so that the opening 125 passes over the base plate 25. He next moves the control lever to its second position shown in Fig. 7, in which it is retained by sideways pressure into a recess 53 on the opposite side of the slot 43 to recess 50. The resultant outward movement of sleeve 41 allows the barrel to move forward to the position shown in chain-dotted lines in Fig. 2, in which it has moved into the recess 49 in the base plate 25, so that the hand can no longer be withdrawn from the wrist fitting. At this stage the

driving member 29 is not yet engaged with the driver 27. Nor has the locking bolt 38 yet been projected from the guide 31, it having advanced only to the chain-dotted position in Fig. 2. The hand can therefore be freely turned in relation to the wrist fitting. When it has been turned to the correct position, the wearer moves the operating lever 42 to the third or outmost position in its slot 43 shown in Fig. 8. This allows the barrel 30 and locking bolt 38 to move to the positions shown in Fig. 4, in which the driving member 29 engages the driver 27 and the locking bolt has engaged one of a number of holes 54 in the base plate 25. The hand is now locked against rotation in relation to the wrist fitting, but to secure it firmly and prevent any chattering a pressure plate 55 is brought into operation by movement of the lever 42 into a lateral recess 56 in the slot 43 (see Fig. 9).

The pressure plate 55 is normally retained in the inoperative position shown in Fig. 2 by a pair of springs 57 interposed between the inner face of the pressure plate and the heads of a pair of associated screws 59 (Fig. 3), which project inwardly from the inner face of the pressure plate. Rotatably mounted on the exterior of the sleeve 36 is a cam plate 60 formed with an inwardly depending flange 61. The flange 61 has a slot 63 conforming in shape with the slot 43 in the sleeve 20 and having recesses corresponding with recesses 50, 53 in the slot 43. Movement of the lever 42 from the position of Fig. 6 through that of Fig. 7 to that of Fig. 8 will therefore have no effect on the cam plate 60. The slot 63, however, has no recess corresponding to recess 53. When therefore the lever 42 is moved into the recess 56 as shown in Fig. 9, the flange 61 will be shifted to the right as seen in Fig. 9 and the cam plate 60 will be rotated clockwise as seen in Figs. 3 and 5. This causes cams 62 on the cam plate 60 to be brought into cooperation with studs 64 which project inwardly from the pressure plate 55 to force the latter outwardly against the action of the springs 57 to hold the base plate 25 of the hand firmly in engagement with the flange 24. As will be noted from Fig. 2, the contacting faces of the cams 62 and the studs 64 are aslant the axes of the studs, so as to effect gradual outward movement of the pressure plate as the cam plate 60 is turned.

To uncouple the hand, the reverse procedure is adopted. The lever 42 is moved first from the position of Fig. 9 to that of Fig. 8, thereby enabling the springs 57 to withdraw the pressure plate 55 to inoperative position. The lever 42 is then retracted directly from the position of Fig. 8 to that of Fig. 6—since there is no purpose in delaying in the position of Fig. 7—whereupon the barrel 30 and locking bolt 37 are withdrawn to the position of Fig. 2. Then if the arm is rested with the finger tips on the table, the hand will drop out of the opening 125 in the wrist fitting by its own weight.

The arrangement of Figs. 10-15 is very similar, except that in this case provision is made for pronation and supination of the hand as the arm is flexed. This movement is communicated to a tube 65 surrounding the shaft 27 as described in United States application Serial No. 646,133. Slidably mounted on the tube 65 is a sleeve 66, having a key 67 engaging a slot 68 in the tube. The sleeve 66 has an outwardly projecting flange 69 and has fixed to it by rivets 70 a pin 71. This pin 71 carries a key 72 engaging a slot 73 in the barrel 30 and a part-circular flange 146 (which

replaces the projection 46 of Fig. 2) cooperating with the projection 45 on the sleeve 41 carrying the operating lever 42. A spring 74 holds the flange in engagement with the projection 45, while the spring 48 normally holds the left hand edge of the slot 73 in the barrel 30 (as seen in Fig. 10) in engagement with the key 72.

When the control lever 42 occupies its first position shown in Fig. 12, the locking bolt 38, barrel 30 and pin 71 are held retracted and the hand can be picked up as previously described. Movement of the control lever 42 to its second position (Fig. 13) as before allows the barrel to move forward into the recess 49 sufficiently to prevent removal of the hand while still permitting of rotation thereof in relation to the wrist fitting. When the control lever 42 is moved outwards into its next position, Fig. 14, in which it is retained by moving the lever into lateral recess 156 the parts assume the position shown in Figs. 10 and 11. The barrel has now moved outwards to the limit of its travel, being arrested by engagement of the driving member 29 with the driver 27, while the sleeve 66 has moved outwards in addition to the sleeve 30 sufficiently for the pin 71 to engage a hole 75 in the base plate 25, the key 72 moving to the right hand end of the slot 73. Consequently rotation of the tube 65 as the arm is flexed will impart the desired pronation and supination movements to the hand. It will be noted that the bolt 3 is still retracted. It should also be mentioned that there is no recess in the slot 63 in flange 61 corresponding to recess 156. Consequently the cam plate 60 will be given a partial rotation, as indicated in Fig. 14, to apply sufficient outward movement to the pressure plate 55 to take up slack, without however pressing the base plate 25 tightly against the flange 24. Rotation of the hand by the tube 65 will impart via the members 27, 29, rotation to the shaft 23. The gearing in the elbow mechanism is, however, at this time disengaged by the selector mechanism described in United States application Serial No. 646,133 and can be rotated idly by the shaft 23.

When the control lever 42 is moved to its fourth and final position, the locking bolt 38 is projected to engage the hole 54 in the base plate to lock the hand against rotation in relation to the wrist fitting. When the projection 45 on the sleeve 41 moves outwards from the position of Fig. 10 to this fourth position it moves a bell crank lever 76 anticlockwise (as seen in Fig. 10) against the action of a spring 77 which normally holds the bell crank in the position shown in Fig. 11, in which a projection 79 on its boss 78 engages a stop 80. This movement of the bell crank causes its long arm 81 to press the flange 69 rearwardly and thereby withdraw the pin 71 from the hole 75. When the control lever 42 is in its fourth position therefore, the pronation and supination gear is disabled. As before, movement of the control lever 42 into the recess 56 is effective to move the pressure plate 55 outwards into its operative position in which it presses the base plate 25 firmly against the flange 24.

The wrist mechanism shown in Figs. 16 and 18 is similar to that of Figs. 1-9, but in this case it is intended for below elbow amputation and the drive is applied to the driving member 29 by a double ended cord 82 wound round it and passing through slots 83 in the barrel 30 and over pulleys 84 supported by brackets 85 on the wrist fitting. The cord 82 is attached to the wearer's

harness so that a pull can be exerted on its opposite ends by shoulder and chest movement respectively to rotate the driving member in the desired direction.

What I claim as my invention and desire to secure by Letters Patent is:

1. In an artificial arm, the combination with a wrist fitting having at its outer end an in-turned flange and having a lateral opening to permit of edgewise engagement therewith of the base plate of an artificial hand, of a driving member displaceably mounted in said wrist fitting, a locking bolt likewise displaceably mounted in said wrist fitting, and an operating member coupled to and serving to control the positions of said driving member and locking bolt, said operating member projecting from the wrist fitting and being movable in relation thereto between a first position in which the drive member and locking bolt are retracted to permit of insertion of the base plate into the wrist fitting and removal of the base plate from the wrist fitting, and a second position in which the drive member and locking bolt are projected so as respectively to be in driving engagement with the hand and to lock the same against rotation in relation to the wrist fitting.

2. In an artificial arm, a combination as claimed in claim 1 comprising a member controlled by the operating member and arranged to be projected, on movement of the operating member from its first position to a position intermediate its first and second positions, to engage a central recess in the base plate to prevent withdrawal of the same from the wrist fitting, said locking bolt being retracted in said intermediate position of said operating member.

3. In an artificial arm, the combination with a wrist fitting having at its outer end an in-turned flange and having a lateral opening to permit of edgewise engagement therewith of the base plate of an artificial hand, of a driving member displaceably mounted in said wrist fitting, a locking bolt likewise displaceably mounted in said wrist fitting, an operating member coupled to and serving to control the positions of said driving member and locking bolt, said operating member projecting from the wrist fitting and being movable in relation thereto between a first position in which the drive member and locking bolt are retracted to permit of insertion of the base plate into the wrist fitting and removal of the base plate from the wrist fitting, and a second position in which the drive member and locking bolt are projected so as respectively to be in driving engagement with the hand and to lock the same against rotation in relation to the wrist fitting, and a pressure plate associated with the wrist fitting and movable under the control of the operating member into position to hold the base plate firmly in engagement with the flange.

4. In an artificial arm, the combination with a wrist fitting comprising an inturned flange at its outer end and having at its side a slot to permit the base plate of an artificial hand to be slid edgewise into position beneath the flange, of a barrel mounted for axial sliding movement in the wrist fitting between a retracted position and a projected position, said barrel serving when projected to engage a hole in the base plate to prevent withdrawal thereof from the wrist fitting, a drive member within the barrel for imparting operating movement to the hand, a locking bolt mounted within the wrist fitting and movable from a retracted position to a projected position

in which it is effective to lock the hand against rotation in relation to the wrist fitting, an operating member projecting from the wrist fitting and movable, by pressure thereon, from a first position through a second position to a third position and back again to the first position and operative connections between the operating member, the barrel, the driving member and the locking bolt, said operative connections maintaining the barrel retracted in the first position only of the operating member, moving the locking bolt to projected position in the third position only of the operating member, and moving the driving member into position to drive the hand in the third position only of the operating member.

5. In an artificial arm, a combination as claimed in claim 4, comprising a pressure plate in the wrist fitting, said pressure plate being movable from a free position to an operative position in which it is effective to press the base plate firmly against the flange, and mechanism controlled by the operating member for moving the pressure plate to operative position after the locking bolt has been moved to projected position.

6. In an artificial arm, a combination as claimed in claim 4, comprising a spring for urging the barrel to projected position, and a projection on the barrel which cooperates with the operating member, when the same is in its first position, to hold the barrel retracted against the action of said spring.

7. In an artificial arm, a combination as claimed in claim 4, in which the operating member is constituted by a lever projecting through an axial slot in the side of the wrist fitting, and comprising a spring for urging the barrel to projected position, a sleeve surrounding the locking bolt and attached to said lever, coacting projections on the sleeve and barrel for controlling the position of the barrel in accordance with the position of the lever in said slot, and means coupling the locking bolt to the sleeve so that the bolt partakes of axial movement of said sleeve.

8. In an artificial arm, a combination as claimed in claim 4, in which the operating member is constituted by a lever projecting through an axial slot in the side of the wrist fitting, and comprising a spring for urging the barrel to projected position, a sleeve surrounding the locking bolt and attached to said lever, coacting projections on the sleeve and barrel for controlling the position of the barrel in accordance with the position of the lever in said slot, and means coupling the locking bolt to the sleeve so that the bolt partakes of axial movement of said sleeve, said slot having lateral extensions for the reception of the lever when in its first and second positions.

9. In an artificial arm, a combination as claimed in claim 4, comprising a pressure plate in the wrist fitting, said pressure plate being movable from a free position to an operative position in which it is effective to press the base plate firmly against the flange, springs for urging the pressure plate to the free position, a rotary cam member in the wrist fitting for engaging coacting surfaces on the pressure plate to move the same to operative position, and means operative on movement of the operating member beyond its third position to rotate said cam member and thereby move said pressure plate to operative position.

10. In an artificial arm, a combination as claimed in claim 4, in which the operating mem-

ber is constituted by a lever projecting through an axial slot in the side of the wrist fitting, and comprising a spring for urging the barrel to projected position, a sleeve surrounding the locking bolt and attached to said lever, coacting projections on the sleeve and barrel for controlling the position of the barrel in accordance with the position of the lever in said slot, means coupling the locking bolt to the sleeve so that the bolt partakes of axial movement of said sleeve, a pressure plate in the wrist fitting, spring means normally holding the pressure plate in inoperative position, and a cam member coacting with the pressure plate and operable to move the same into an operative position in which it is effective to press the base plate against the flange, said cam member having a flange with a slot registering with the slot in the wrist fitting accommodating the lever and said last mentioned slot having, at the third position of said lever, a lateral recess, whereby movement of said lever into said recess is effective to rotate said cam member to move said pressure plate to operative position.

11. In an artificial arm, the combination with a wrist fitting comprising an inturned flange at its outer end and having at its side a slot to permit the base plate of an artificial hand to be slide edgewise into position beneath the flange, of a barrel mounted for axial sliding movement in the wrist fitting between a retracted position and a projected position, said barrel serving when projected to engage a hole in the base plate to prevent withdrawal thereof from the wrist fitting, a drive member within the barrel for imparting operating movement to the hand, a locking bolt mounted within the wrist fitting and movable from a retracted position to a projected position in which it is effective to lock the hand against rotation in relation to the wrist fitting, a rotary drive shaft coupled to said driving member, a rotary tube surrounding said drive shaft and serving to impart pronation and supination movement to the hand as the arm is flexed, and an operating member projecting from the wrist fitting and coupled to the barrel, the drive member, the locking bolt and the tube, said operating member serving when in a first position to

hold the barrel, the drive member, the locking bolt and the tube retracted, so that the base plate can be freely inserted into the wrist fitting, when in the second position to project the barrel into position to engage a central recess in the base plate, when in a third position to couple the tube to the base plate to enable the base plate to be rotated by the tube, and when in a fourth position to project the bolt to locking position and to project the drive member to position to engage the hand and drive the same.

12. In an artificial arm, a combination as claimed in claim 11, wherein movement of the operating member to the fourth position is effective to uncouple the tube from the base plate.

13. In an artificial arm, a combination as claimed in claim 11, comprising a normally retracted pressure plate in the wrist fitting and mechanism controlled by the operating member for moving the pressure plate into position to take up slack between the base plate and flange on movement of the operating member to its third position for moving it further to press the base plate tightly against the flange on movement of the operating member to its fourth position.

14. In an artificial arm, a combination as claimed in claim 4, comprising a double-ended traction cord surrounding the drive member within the wrist fitting, said cord being operable to impart rotary driving movement to said drive member.

JOYCE OTTERMAN.

REFERENCES CITED

35 The following references are of record in the file of this patent:

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Number	Country	Date
40 133,717	Great Britain -----	Oct. 23, 1919
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