

1,298,502.

F. C. HENNING,
ARTIFICIAL HAND.
APPLICATION FILED FEB. 1, 1918.

Patented Mar. 25, 1919.
3 SHEETS—SHEET 1

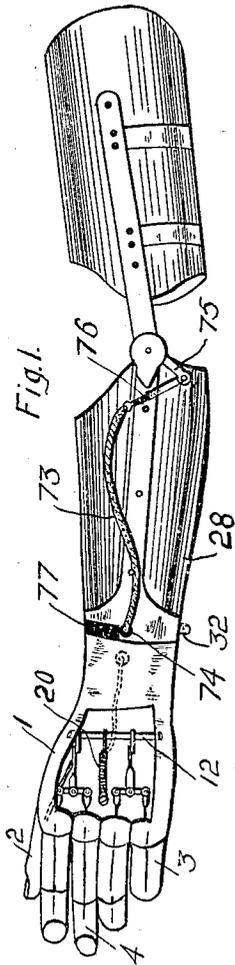


Fig. 1.

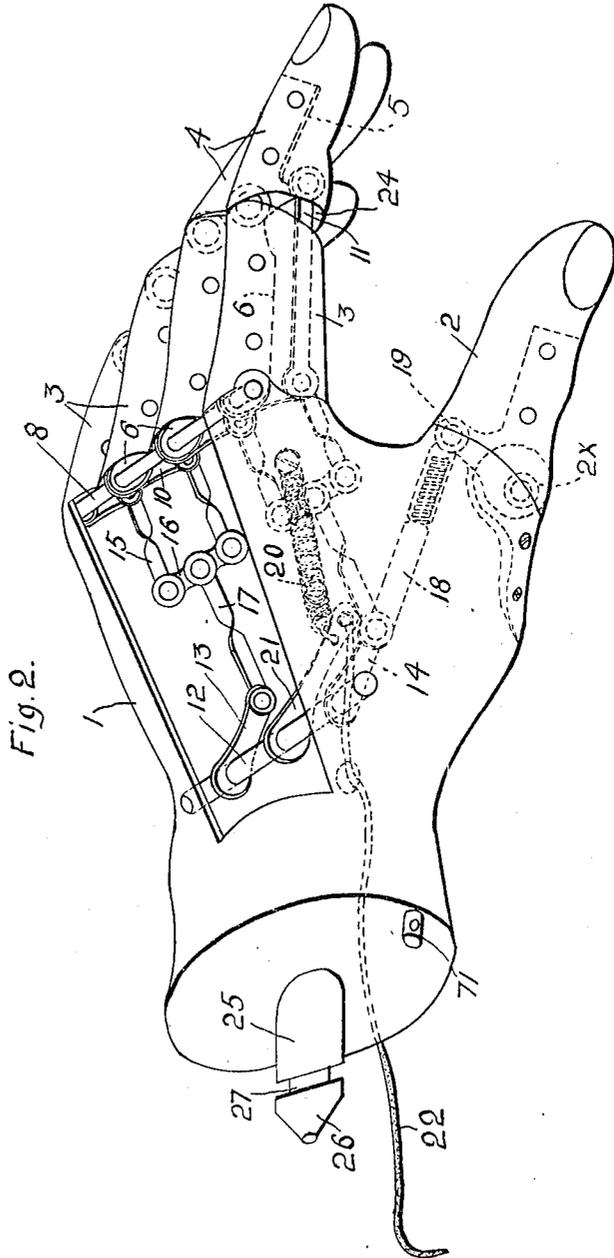


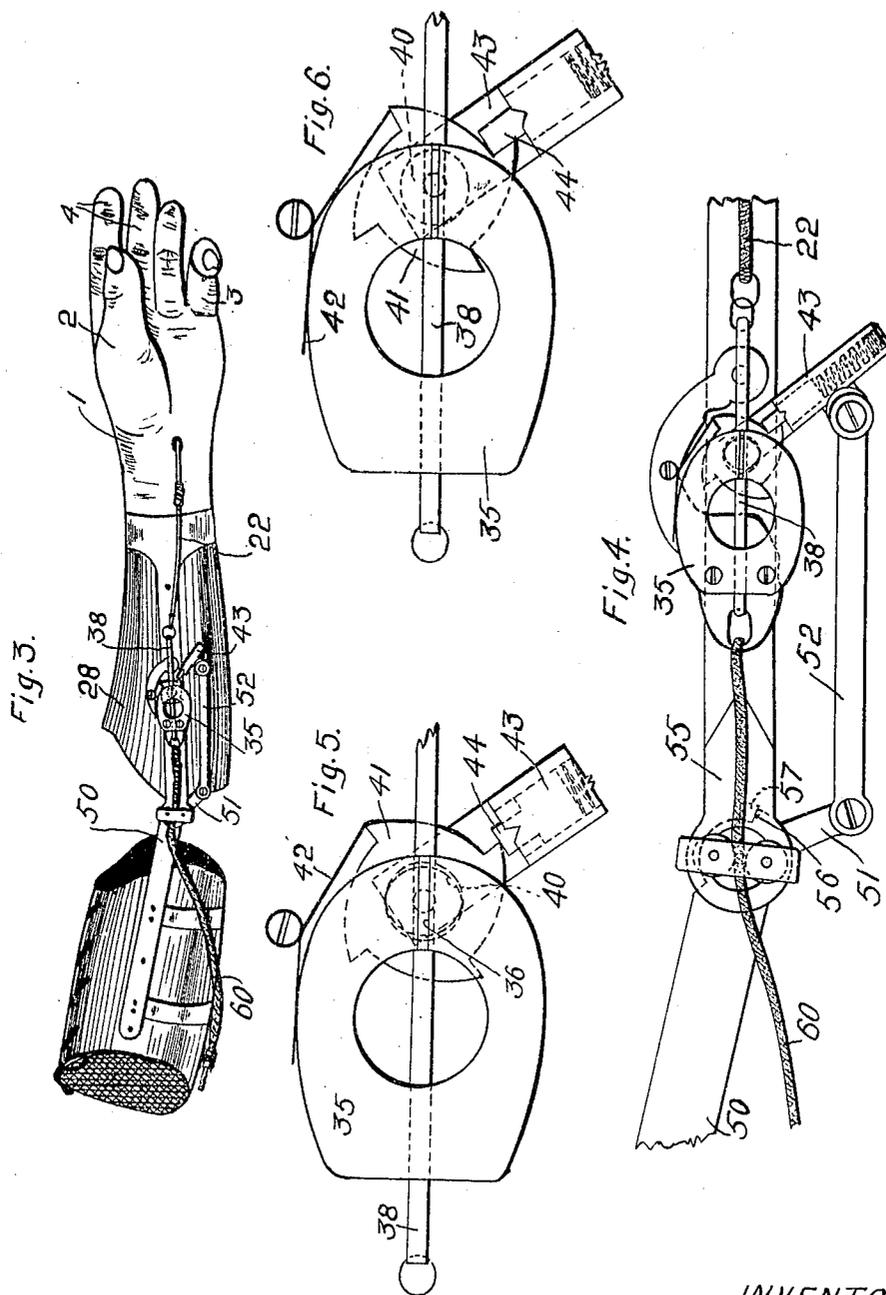
Fig. 2.

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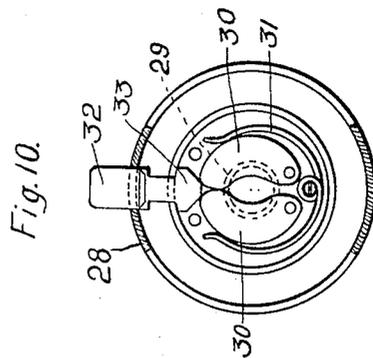
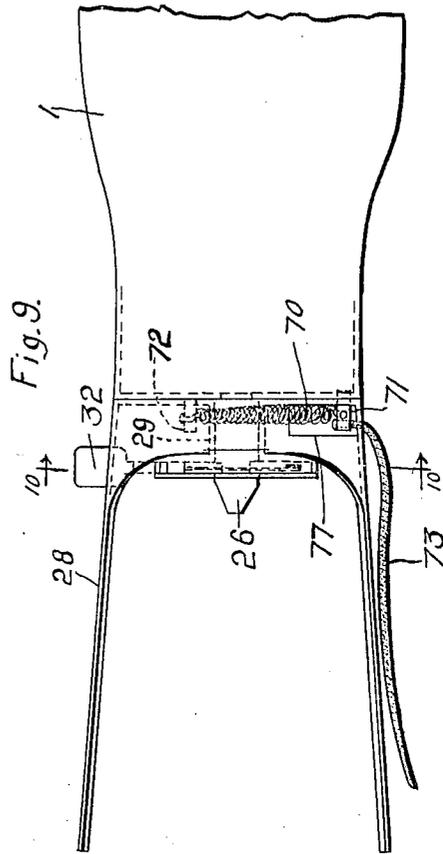
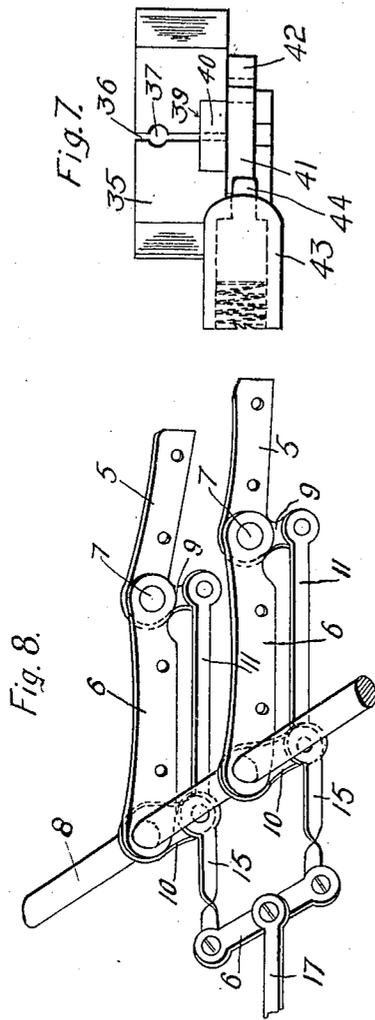
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3 SHEETS—SHEET 3.



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UNITED STATES PATENT OFFICE.

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ARTIFICIAL HAND.

1,298,502.

Specification of Letters Patent. Patented Mar. 25, 1919.

Application filed February 1, 1918. Serial No. 214,824.

To all whom it may concern:

Be it known that I, FREDERICK C. HENNING, a citizen of the United States, residing at Chicago, county of Cook, State of Illinois, have invented a certain new and useful Improvement in Artificial Hands, and declare the following to be a full, clear, and exact description of the same, such as will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

My invention has for its object to produce an artificial hand in which the fingers and thumb shall possess a degree of flexibility which will permit them to be opened and closed in such a manner as effectively to grasp articles of various sizes and shapes. Viewed in one of its aspects my invention may be said to have for a subsidiary object the production of a novel digit for an artificial hand.

A further object of the present invention is to produce a simple and novel means for locking the fingers and thumb of an artificial hand in a closed position, retaining them in such position while the hand is moved about in various directions, and unlocking them at will.

A further object of the present invention is to produce a simple and novel construction and arrangement which will permit an artificial hand to be quickly connected and disconnected to the arm members without affecting the adjustment of any of the principal mechanisms.

The various features of novelty whereby my invention is characterized will hereinafter be pointed out with particularity in the claims; but, for a full understanding of my invention and of its objects and advantages, reference may be had to the following detailed description taken in connection with the accompanying drawings, wherein:

Figure 1 is a rear elevation of an artificial hand arranged in accordance with my invention, together with the attaching members adapted to support the hand from points above and below the elbow of the wearer;

Fig. 2 is a perspective view on an enlarged scale, of the hand detached from the supporting parts;

Fig. 3 is a view of the same parts shown

in Fig. 1, showing the opposite side from that which appears in Fig. 1;

Fig. 4 is a view on an enlarged scale of the lock and lock-controlling parts shown in Fig. 3, the parts being shown in the positions in which the locking devices are open;

Fig. 5 is a view on a somewhat larger scale than Fig. 4 showing only the lock device in an unlocked or open position, differing from the position shown in Fig. 4 in that movements of the hand and forearm within limits will have no effect on the locking device while the parts occupy the position shown in Fig. 5;

Fig. 6 is a view similar to Fig. 5 showing the locking device in its locked or closed position;

Fig. 7 is an end view of the locking device, looking toward the right hand side of Fig. 6;

Fig. 8 is a detail of some of the finger joints and operating connections;

Fig. 9 is an elevation on the same scale as Fig. 2 of the wrist portion of the hand and the adjacent portion forearm member; and

Fig. 10 is a section taken approximately on line 10—10 of Fig. 9.

In the drawings I have illustrated my invention as applied to a structure adapted to be worn by one retaining a portion of the forearm and, for the sake of brevity, I shall confine the detailed description of my invention to this embodiment although it will of course be understood that the various features of my invention may be used in other relations.

Referring to the drawings, 1 represents a hollow member of any suitable material having the shape of a hand minus the thumb and fingers and including a wrist. 2 is a thumb member pivotally connected adjacent to the outer edge of its base to the body member of the hand as indicated at 3. The fingers are each made up of a third joint, 3, and a combined first and second joint, 4; the finger members being made hollow and of any suitable material. The two members of each finger may conveniently be connected together and to the body of the hand by means of pivotally connected arms or links, best shown in Fig. 8. Referring to this latter figure, 5 is a metal piece adapted to be secured in the member 4 of one of the fingers and 6 is a metal piece adapted to extend through and be secured in the member 3 of the corresponding finger. The members 5

and 6 are pivotally connected together as indicated at 7; the pivotal point being at the joint between the members 3 and 4. A rod, 8, extends transversely through the member 5 1 just beneath the location of the knuckles in a human hand and the rear ends of the pieces 6 are journaled on this rod. The journaling of the members 6 on the rod 8 may conveniently be effected by drilling holes 10 of the proper size in the member 6 and inserting the rod through them. Each of the pieces 5 has integral therewith a downwardly extending arm, 9, forming therewith 15 elements 6 is an arm, 10, hung upon the rod 8 so as to be capable of swinging freely on the rod independently of the corresponding element 6. Each of the arms 9 is connected 20 to the free end of the corresponding arm, 10, by means of a connecting rod, 11. It will be seen that the hinge joints are all near the back surface of the hand while the pivotal connections at the ends of the connecting rods are all in the vicinity of the inner side 25 of the hand, that is as far removed from the hinge axes as the thickness of the fingers will permit. This affords a powerful leverage for giving to the hand a strong grip.

Housed within the member 1 near the 30 wrist is a rock shaft, 12, lying parallel with the rod 8. Two radially extending rocker arms, 13 and 14, are rigidly connected to the rock shaft. Between the free end of the arm 13 and the third and fourth fingers is an 35 equalizing actuating mechanism which may conveniently take the form of two connecting rods, 15, connected to the free ends of the swinging arms, 10, corresponding to the third and fourth fingers and connected also at their 40 opposite ends to an equalizing bar, 16; a connecting rod, 17, being pivotally connected at one end to the middle of the equalizing bar and being connected at its other end to the free end of the rocker arm, 13. A similar 45 equalizing actuating mechanism extends between the rocker arm, 14, and the first and second fingers. An adjustable connecting rod, 18, extends from the free end of the rocker arm, 14, to a point, 19, at the base of 50 the thumb member 2, at a considerable distance from the pivotal axis 3, preferably on the opposite side of the thumb from this axis. A spring, 20, attached to a third rocker arm, 21, on the shaft 12 tends always to hold the 55 shaft in a position wherein the actuating mechanisms are thrust forward toward the fingers as far as they will go, holding the hand in the open position as shown in Fig. 2. When the rock shaft is turned against 60 the tension of the spring 20 as, for example, by means of a cord, 22, attached to the rocker arm 21, the first action is to draw the ends, 4, of the fingers inwardly. Then, when the bases of the members 4 on the inner side of 65 the hand engage with the outer ends of the

members 3, the latter members will be swung inwardly about the axis of the rod 8; the meeting ends of the members 3 and 4 being so shaped, as best shown in Fig. 2, that when the hand is open there is a gap, 24, between 70 each member 3 and the corresponding member 4 which is widest on the inside of the hand and decreases gradually in width so that it may be substantially closed on the back or upper side of the hand. The equal- 75 izing mechanism between the operating shaft and the fingers gives the fingers a high degree of flexibility so that they will adjust themselves readily to the contour of an article to be grasped. At the same time that 80 the fingers are closing the thumb is also moving inwardly toward the fingers and the palm of the hand.

My improved hand may be attached to any suitable arm member. To facilitate ready 85 attachment and detachment I provide the hand with a rearwardly projecting post, 25, formed at the axis of the wrist, the post being pointed, as indicated at 26, at its rear end and being provided with an annular groove, 90 27, just in front of the pointed end. The arm member, 28, is provided with a hole or tunnel, 29, through which the post 25 may project and in which it may be seated. At the rear or inner end of the bearing 29 are two 95 hinged half disks, 30, pivotally connected at corresponding ends to the members 29 so as to be capable of swinging back and forth at right angles to the axis of the opening 29 and from positions in which the opening is 100 left unobstructed to positions in which the opening is partly closed. A suitable spring or springs, 31, as best shown in Fig. 10, presses the members 30 toward each other. A push button, 32, projecting inwardly from 105 the exterior of the member 28 and having a wedge-shaped inner end, 33, serves to press the members 30 apart from each other, when desired, so as to leave the opening, 29, unobstructed. The members 30 are approxi- 110 mately as thick as the width of the groove 27 in the post 25 and the parts are so proportioned that when the hand member is seated firmly against the end of the arm member, the groove in the post will be in 115 the same plane as the half disks, 30. Therefore, when the post is slipped into the opening or bearing 29 as far as it will go, the pointed end enters between the half disks 30 and spreads them apart. As soon as the post 120 has been pushed in far enough to bring the groove 29 in registration with the members 30, these members spring into the groove and lock the hand to the arm member. When it is desired to detach the hand from the arm 125 member, an inward pressure on the push button 32 will spread the locking elements 30 apart and permit the post to be withdrawn and the hand to be freed.

Another important feature of my inven- 130

tion is a simple and effective locking device for holding the hand closed upon an object which it may be grasping, while permitting the hand to be moved about freely. To this end I have mounted on the forearm member, 28, a C-shaped piece, 35, preferably of steel; the opening, 36, between the free ends of the piece being narrow, preferably a saw slot. A hole, 37, of greater diameter than the width of the slot, 36, is drilled through the member 35, a portion of this opening lying in each of the two bounding faces of the slot. The actuating cord, 22, for the fingers is attached at its rear end to a rod, 38, which passes through the opening 37; the rod being somewhat larger in diameter than the opening so that it will be held in a vise-like grip by the member 35. In one side of the member 35 is a recess, 39, portions of which lie in both of the jaw members of the vise. In this recess is a cam, 40, which may conveniently be a small elliptical piece having such dimensions that when its minor axis is at right angles to the plane of the slot 36 it does not interfere with the vise-like action of the member 35 whereas, upon turning it through an angle of 90 degrees so as to bring its major axis at right angles to the plane of the slot 36, the two jaws of the vise are spread apart so as to release the grip on the rod 38 and permit the rod to move or be moved freely. The cam is rigidly connected to a ratchet wheel, 41, having four teeth distributed at equal distances around the same. A spring, 42, is adapted to engage with the ratchet teeth to prevent backward movement of the wheel. Associated with the ratchet wheel is an actuating arm, 43, movable independently of the wheel but about the same axis. On the actuating arm is a spring pressed pawl preferably in the form of a flat-ended pin, 44, which is adapted to engage with the teeth of the ratchet wheel for the purpose of rotating the wheel.

The arm 43 is actuated by the act of bending the elbow in the following manner: On a bar, 50, or other part adapted to be attached to the arm above the elbow is an arm, 51, which projects radially from the pivotal axis between the members 28 and 50. The free end of the arm 51 is connected to the actuating arm 43 by means of a connecting rod, 52. By an inspection of Fig. 3 it will be seen that if the hand is raised so as to bend the elbow, the joint between the members 51 and 52 being stationary, the arm 43 must swing in the clockwise direction; the parts being so proportioned and arranged that the arm 43 moves through the same angle as the forearm and hand. In other words, if the hand is raised through an angle of 90 degrees, relatively to the upper arm, the actuating arm, 43, will be turned through an angle of 90 degrees.

In normal unlocked position, the square end of the pin or pawl, 44, resting on one of the teeth of the ratchet wheel. The forearm, 20, and the member 50 may be so constructed that whenever the actuating arm 43 reaches the position shown in Fig. 5, this being also the position shown in Figs. 3, 4 and 6, further movement of the forearm in the direction to straighten the arm will be arrested. This may conveniently be accomplished by providing the member 50 and a similar member, 55, on the forearm with cooperating stops, 56 and 57, which will engage with each other when the arm has been straightened. When the parts are in the position shown in Fig. 5 the actuating rod, 38, for the fingers is released, so that the hand may be opened and closed at will by manipulating the rod 38 in any suitable way as, for example, by means of a cable, 60, or otherwise. The arm may be bent and straightened out at will without affecting the locking device provided that the forearm is not raised through an angle somewhat less than 90 degrees. If the forearm is raised through an angle of 90 degrees it will cause the pawl of the actuating arm 43 to travel back far enough to engage the first tooth to the left, as viewed in Fig. 5, turning the ratchet wheel just far enough so that when the arm is again straightened the tooth which in Fig. 5 is just under the pawl 44 will now be behind it as shown in Fig. 4. Consequently, while the actuating rod for the fingers will still be free, the next bending movement of the arm will cause the ratchet wheel to be turned around to or toward the position shown in Fig. 6, releasing the gripping jaws and permitting them to close upon and hold the actuating rod. It will thus be seen that the hand and arm may be moved within limits with perfect freedom without bringing the locking device for the fingers of the hand into play but, when it is desired to lock the hand in a closed position, the forearm need only be swung twice through an angle of 90 degrees in order to bring the locking device into play. Then, when it is desired to unlock the hand a single movement of the forearm from the straight position through an angle slightly less than 90 degrees, will turn the ratchet wheel into the position shown in Fig. 5. If the unlocking movement of the forearm should be through an angle of 90 degrees, then the next upward movement of the forearm from a straight position would result in again causing the device to lock.

It is desirable that when the hand is raised as, for example, when a man raises his hand to grasp his hat, the hand be turned bodily. This may conveniently be accomplished by causing the hand to turn about the axis of the post 25 and in the supporting bearing for the post. In the arrangement shown, there is a spring, 70, connected at its ends to a pin, 130

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71, projecting from the rear face of the wrist end of the hand member and a pin, 72, on the forearm member 28. This spring normally holds the hand against accidental turning. A cord or cable, 73, extends through a guiding hole, 74, in the member 28 and is attached to the pin 71; the pin being normally displaced angularly at a considerable distance from the hole through which the cord or cable passes so that when the latter is pulled it will cause the hand to be turned against the tension of the spring. One end of the cable 73 is attached to an arm, 75, similar to the arm 51 and similarly mounted except that it is on the opposite side of the limb. There is sufficient slack in the cord or cable 73 to permit the hand to be raised through a considerable angle without producing any turning movement but, after the hand has been raised through an angle of say 45 degrees, a turning movement of the hand will take place. The point at which such turning movement will take place may be regulated by means of a slack adjuster, 76, between the end of the cord or cable 73 and the arm 75.

The member 28 is preferably provided with a slot, 77, overlying the path of movement of the pin 71 so that access may readily be had to the connection between the cord or cable and the pin for the purpose of connecting and disconnecting the same. It will be seen that by providing a detachable connection between the cord or cable and the pin 71, the entire hand may be detached after first disconnecting the cord or cable by simply pressing the button 32 and without disturbing any of the mechanisms.

I claim:

1. In an apparatus of the character described, two relatively-movable artificial limb members, a lock, a lock-controlling device, a ratchet wheel connected to said device for actuating the same, and means interconnected with said members for moving said ratchet wheel step by step through successive predetermined relative movements of said members from a predetermined relative position of said members.

2. In an apparatus of the character described, an upper arm member, a forearm member, a lock, means including a ratchet wheel for controlling the lock, and means interconnected with said members for moving said ratchet wheel step by step through successive flexing movements of said arm members through an angle of approximately ninety degrees from a straight arm position.

3. In an apparatus of the character described, an upper arm member, a forearm member, a lock having gripping jaws, a cam for spreading said jaws apart, a ratchet wheel connected to said cam, and means interconnected with said members for moving

said ratchet wheel step by step through successive flexing movements of said arm members through a predetermined angle from a straight arm position.

4. In an apparatus of the character described, an upper arm member, a forearm member, a hand having movable fingers, a controlling means for said fingers, a lock for said controlling means, and means controlled by relative movements of said arm members for operating said lock.

5. In an apparatus of the character described, an upper arm member, a forearm member, a hand having movable fingers, a controlling device for said fingers, a lock for said device, means including a ratchet wheel for operating the lock, and means interconnected between said arm members for moving said ratchet wheel step by step through successive relative movements of said members through a predetermined angle from a straight arm position.

6. In an apparatus of the character described, an arm member having a bearing, a hand member having a post adapted to fit into said bearing, said post having an annular groove, two catch members movably mounted on said arm member and adapted to engage each other along a line lying in front of said bearing, spring means tending to press said catch members toward each other, and means for spreading said catch members apart, said catch members being provided in their meeting edges with registering semicircular notches having a radius less than that of the post.

7. In an apparatus of the character described, a hand member, a finger hinged at its base to the hand member and having at an intermediate point a hinge joint in the vicinity of the back or outer side of the finger, an arm hung in the vicinity of the base of the finger, a connecting rod extending from the free end of said arm to a point lying in the vicinity of the said hinge joint in the finger and near the inner side of the finger, the adjacent ends of the finger members having stops to limit the relative angular movements in the closing direction, and means for actuating said rod.

8. In an apparatus of the character described, a hand member, a finger hinged to the hand member at its base and provided between its ends with a hinge joint located near the back or outer surface of the finger, a rod extending longitudinally through the inner end of the finger to the vicinity of said hinge joint, and a connection between said rod and the finger as far removed from the hinge joint in the finger as the thickness of the finger will permit.

9. In an apparatus of the character described, a hand member, a finger hinged to the hand member and comprising a third

joint and a combined first and second joint hinged together, an arm hung in the vicinity of the base of the finger, a connecting rod extending from the free end of said arm to the combined first and second joint, the adjacent ends of the finger members having stops to limit the relative angular movements in the closing direction, and means in said hand member for actuating said connecting rod.

10. In an apparatus of the character described, a hand member, a finger hinged to the hand member and comprising a third joint and a combined first and second joint hinged to the third joint, the adjacent ends of the finger members having stops which engage each other when the finger members have been moved relatively to each other through a predetermined angle in bending the finger, an actuating element extending through the third joint member and attached to the other finger member in front of the hinge axis between the hinge members, and means for moving said actuating element a sufficient distance to bend said finger member and then swing it inwardly about its hinge connection with the hand member.

11. In an apparatus of the character described, a hand member, a finger hinged to the hand member and comprising a third joint and a combined first and second joint, said joints being hinged together in the vicinity of the knuckle, an arm hung in the base of the finger so as to be capable of swinging about the hinge axis between the finger and the hand member, a connecting rod extending from the free end of said arm to a point at the base of the second joint spaced apart from the corresponding hinge axis a distance approximately equal to the length of said arm, and means in said hand member for actuating said connecting rod, the meeting ends of the finger members being constructed and arranged to engage with each other and prevent further bending of the finger after a predetermined amount of bending has taken place.

12. In an apparatus of the character described, a hand member, a shaft extending transversely through the hand member in the vicinity of the knuckles, fingers hung on said shaft, a thumb hinged to said hand member, a rock shaft in said hand member in rear of the aforesaid shaft, operating connections between said rock shaft and the fingers and thumb, a spring tending to turn said rock shaft in the direction to open the hand, and means for actuating the rock shaft in the direction to close the hand.

13. In an apparatus of the character described, an upper arm member, a forearm member, a hand having movable fingers, a lock for holding said fingers against move-

ment, and means controlled by the relative movements of said arm members for locking and unlocking the lock.

14. In an apparatus of the character described, an upper arm member, a forearm member, a hand member having movable fingers, a lock for holding said fingers against movement, and connections between both of said arm members and said lock for causing the latter to be alternately locked and unlocked by successive movements of said arm members from a straight arm position through a predetermined angle.

15. In an apparatus of the character described, an upper arm member, a forearm member, a hand having movable fingers, a lock for holding said fingers against movement, connections between said lock and both of said arm members including a lost motion enabling said arm members to be moved back and forth from a straight arm position through a predetermined angle without affecting the lock, said connections being constructed and arranged to cause the lock to be alternately locked and unlocked through successive bending movements of the arm through an angle greater than the aforesaid angle.

16. In an apparatus of the character described, an upper arm member, a forearm member, a hand having movable fingers, a lock for holding said fingers against movement, means including a ratchet wheel for controlling the lock, and means interconnected with said arm members for moving said ratchet wheel step by step through successive flexing movements of said arm members through a predetermined angle.

17. In an apparatus of the character described, an upper arm member, a forearm member, a hand member having movable fingers, a lock for holding said fingers against movement, means including a ratchet wheel having four teeth for alternately locking and unlocking the lock as the ratchet wheel is turned through successive ninety degree angles, an actuating pawl for said wheel, and connections between said pawl and said arm members causing said pawl to move through angles corresponding to the angles of relative movement between said arm members.

18. In an apparatus of the character described, a hand having movable fingers, a rod connected to said fingers, a comparatively heavy block of resilient metal having a jaw provided with registering seats partially surrounding the rod and adapted to grip the same firmly, and means for spreading said jaw so as to release the rod.

19. In an apparatus of the character described, a hand member, a finger hinged to the hand member at its base and provided between its ends with a hinge joint located

near the back or outer surface of the finger, a rod extending longitudinally through the inner end of the finger to the vicinity of said hinge joint, a connection between said rod and the finger as far removed from the hinge joint in the finger as the thickness of the finger will permit, the adjacent ends of the finger members having stops to limit the relative angular movements in the closing direction.

20. In an apparatus of the character described, a hand member, a finger connected at its base to the hand member, a hinge joint arranged in said finger between the ends thereof and in the vicinity of the back or outer side of the finger, and an actuating member extending longitudinally through the base of the finger to a point opposite said hinge joint and in the vicinity of the front or inner side of the finger.

21. In a fingered hand, three members arranged end to end and hinged together in the vicinity of the back or outer surface, a connecting rod extending through the intermediate member and terminating at its ends opposite to the hinge joints at the ends of the latter member, an arm mounted loosely so as to swing about the hinge at the inner or rear end of the intermediate member connected to the rear or inner end of said rod in the vicinity of the inner side of the intermediate member, and a connection between

the outer end of said rod and the finger member lying beyond the intermediate member in the vicinity of the inner side thereof.

22. In an apparatus of the character described, a hand member, a shaft extending transversely through the hand member in the vicinity of the knuckles, fingers hung on said shaft, said fingers having joints therein, a thumb hinged to said hand member, a rock shaft in said hand member in rear of the aforesaid shaft, arms hung upon the first-mentioned shaft, connecting rods extending through the fingers from said arms and connected at their front ends to the finger members beyond the joints in the fingers, connections between said arms and said rock shaft, a spring tending to turn said rock shaft in the direction to open the hand, and means for actuating the rock shaft in the direction to close the hand.

23. In an apparatus of the character described, two artificial limb members hinged together, a lock, a lock-controlling device, and operating connections for said lock-controlling device including parts interconnected between said limb members and adapted to translate the movement of said limb members relatively to each other into a movement of the lock-controlling device.

In testimony whereof, I sign this specification.

FREDERICK C. HENNING.