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Yakobson et al.

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[54] **ELECTRICALLY DRIVEN ARTIFICIAL HAND FOR UPPER EXTREMITY PROSTHESIS**

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[52] **U.S. Cl.** **3/1.1,** 3/12.7

[51] **Int. Cl.** **A61f 1/00,** A61f 1/06

[58] **Field of Search** 3/1.1, 12–12.8

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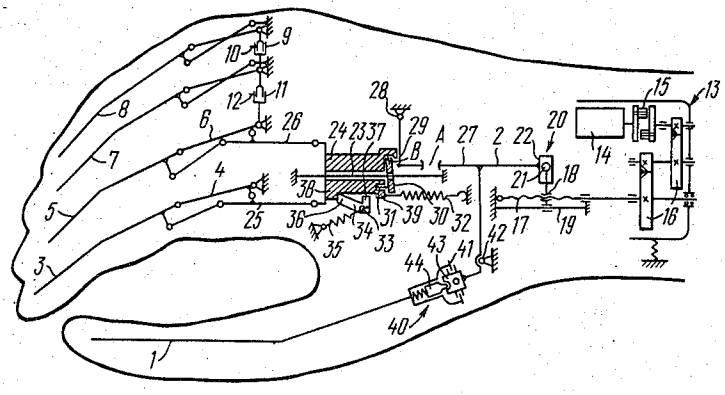
[57] **ABSTRACT**

An artificial hand for upper extremity prosthesis, comprising a reversible electric drive controlled by, for example, bioelectric potentials produced by muscles, and kinematically associated with an actuating lever of the thumb and with at least one for the thumb-opposing fingers. The mechanical linkage interconnecting the electric drive with said thumb-opposing finger is essentially a disengageable unidirectional linkage capable of ensuring that the positive effect of the electric drive upon said finger occurs solely in the direction of extension thereof. The thumb-opposing finger is coupled to a spring actuating it in the direction of flexion thereof, and is provided with a lock to prevent it from being extended under any external force.

12 Claims, 5 Drawing Figures



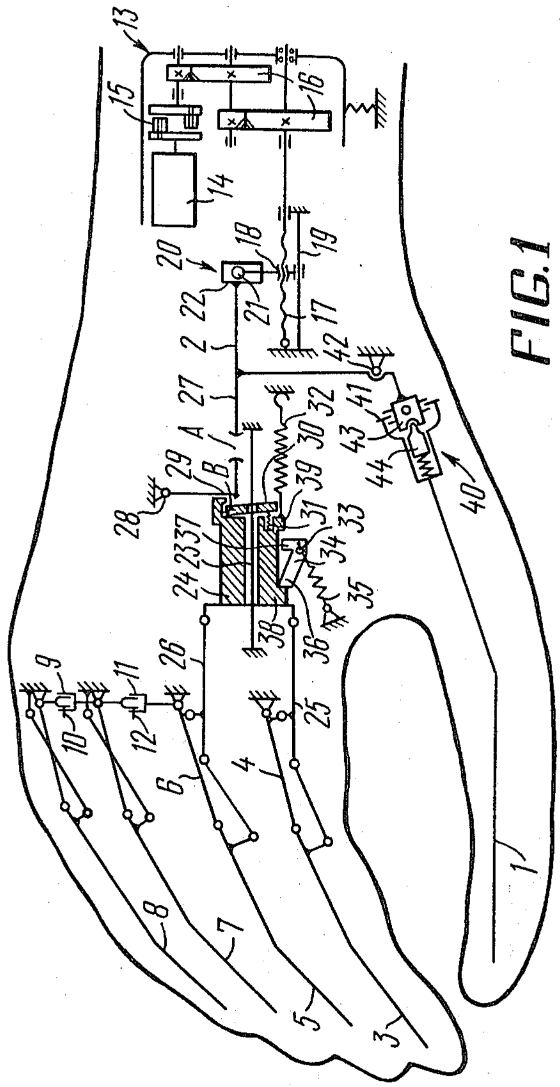

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FIG.1

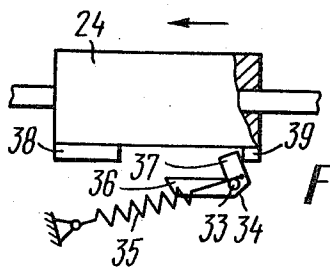

FIG. 2

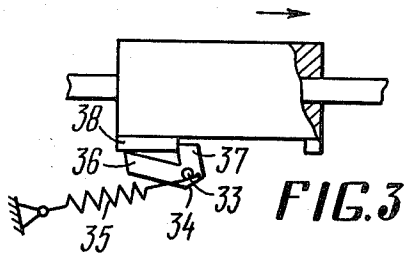

FIG. 3

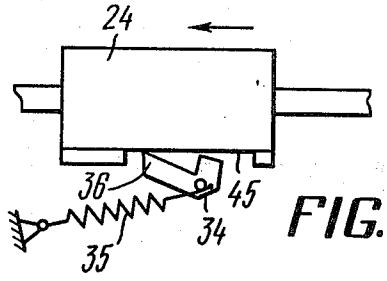

FIG. 4

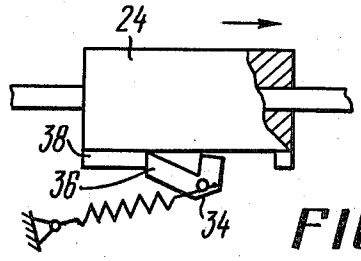

FIG. 5

ELECTRICALLY DRIVEN ARTIFICIAL HAND FOR UPPER EXTREMITY PROSTHESIS

BACKGROUND OF THE INVENTION

This invention relates to medical engineering and has particular reference to prostheses application, and more specifically, to artificial hands for upper extremity prosthesis.

PRIOR ART

Known in the present state of the art of prosthetics is an artificial hand for upper extremity prosthesis (see USSR Author's Certificate No. 267,811), comprising fingers and a single electric drive kinematically associated with the slide block which is interconnected with the thumb through an articulated linkage and with the other four fingers through a rocker-joint actuator enabling a grasping action. In addition, the rocker arm of the two last digits (the ring and the little fingers) is spring-retracted, whereby said fingers are spring-forced against the palm.

When in the grasping position but with no object gripped, these fingers are force-flexed against the palm, while the fore and middle fingers together with the thumb make the finger-pinch grasp. With the slide block performing its full stroke from the electric motor in the direction of the hand opening, the spring becomes tensioned to make all the fingers extend.

In case the last two digits are to grasp a cylindrical object or are retracted to grasp the grip of a briefcase or handbag, the fore and middle fingers, with the slide block in the position corresponding to the finger-pinch grasp, are flexed to a greater extent than in the preceding case and their position corresponds to the first grasp, with this being due to the provision of a rocker-joint actuator.

However, the artificial hand now in common use suffers from an inadequate stability and a low force of finger-pinch grasp; moreover, it takes much time for a fist grasp to occur and in some cases the latter is difficult to make due to the necessity to apply some force to retract the last two digits.

Furthermore, the artificial hand used currently is constructionally complicated as it involves the use of a rocker-joint actuator.

OBJECT AND SUMMARY OF THE INVENTION

It is therefore an essential object of the present invention to provide an artificial hand for upper extremity prosthesis as well employ a single low-power electric motor and simple mechanical actuators accommodated within the palm, featuring a convenient and easy control of the fingers by two control signals and enabling the possibility of performing the principal kinds of grasp, i.e., finger-pinch, fist, lateral and fist-lateral grasps, with these taking a minimum amount of time to bring about and having a considerable force and high stability of grasp.

The above object is accomplished due to the fact that in an artificial hand for upper extremity prosthesis, comprising fingers, a reversible electric drive controlled by bioelectric potentials of the muscles, with said drive being kinematically coupled to the actuating lever of the thumb and to at least one of the fingers opposing the thumb, according to the invention the mechanical linkage interconnecting the reversible electric drive and said thumb-opposing finger is essentially a

disengageable unidirectional (non-reversible) linkage ensuring the positive effect of the reversible electric drive upon said finger occurring only in the direction of extension thereof, with said finger being associated with a spring which actuates the same in the direction of flexion thereof and being provided with a lock to ensure against extension of said finger caused by any external force applied thereto.

It is preferred that the mechanical linkage of the electric drive with said thumb-opposing finger be effected through a slide block connected to the latter, with the block being mounted in guide-ways for free reciprocation therealong and adapted to interact with a pushrod fixed to the actuating lever of the thumb.

The lock preventing said finger against being extended from any external force, may be defined by a movable wedging plate with a hole through which a guide stem passes, with said plate being movably mounted on the slide block at a point removed from the guide stem at a distance enabling its becoming askew and being self-wedged with respect to said guide stem.

It is desirable that the slide block and the self-wedging plate be located on a common guide stem.

It is likewise preferred that the self-wedging plate be spring-actuated with respect to the slide block in the direction of its self-wedging when said slide block travels to extend said thumb-opposing finger.

The artificial hand of the invention may be provided with a rocking pressure strip adapted to interact by one of its sides with the pushrod provided on the actuating lever of the thumb, and by the other side, with the movable self-wedging plate at the point enabling it to be unwedged when motion is transmitted from the pushrod to the slide block.

The present artificial hand is also preferably equipped with an automatic stop lock to fix said thumb-opposing finger in the position corresponding to finger-pinch grasp.

The automatic stop lock may be a rocking strip articulated to the artificial hand and connected to a throw-over spring which serves to fix said strip in its extreme positions, and provided with projections, while the slide block in this case is provided with the corresponding beads to interact with the strip projections.

It is advantageous that the rocking strip have a projection to bring it from the extreme positions and another projection to fix the slide block in the position of the finger-pinch grasp.

It is advisable that the ring and little fingers be interlinked with the fore and middle fingers whose main phalanges are dead-fixed to each other, via a friction coupling provided with a positive stop to restrict the degree of their extension with respect to the fore and middle fingers.

It is preferable to interconnect the little finger with the ring finger through a friction coupling having a positive stop to restrict the degree of extension of the little finger with respect to the ring finger.

The present artificial hand enables finger-pinch, fist, lateral and fist-lateral grasps to be made with the use of only two control signals so as to attain a reasonably high finger approximation rate during grasping, which is due to the fact that flexion of the thumb-opposing fingers is spring-actuated. The use of present artificial hand is instrumental in the attainment of a higher grasping force which is due to the fact that, when grasp-

ing, the thumb-opposing fingers serve as a fixed rest and the entire power of the electric drive is imparted to the thumb, as well as in the attainment of higher stability, reliability and accuracy of a finger-pinch grasp due to the provision of a positive linkage between the main phalanges of the fore and middle fingers and a lock to fix the slide block in the position corresponding to finger-pinch grasp. These advantages of the present artificial hand conjoin with a simple and reliable construction thereof, with small size enabling all the mechanisms of the artificial hand, electric motor inclusive, to be accommodated in the metacarpal portion thereof. Also, the use of only two independent control signals makes the control of the artificial hand easy and convenient and is conducive to the elaboration of automatism of its control attainable in the course of training.

The nature of the present invention is explained in the following disclosure of its exemplary embodiments given by way of illustration to be considered in conjunction with the accompanying drawings, wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a kinematic diagram of an artificial hand for upper extremity prosthesis, according to the invention; and

FIGS. 2 through 5 illustrate a variety of relative positions of the slide block and the automatic stop lock to fix the fore and middle fingers in the position corresponding to a finger-pinch grasp.

DETAILED DESCRIPTION OF THE INVENTION

Reference is now directed to FIG. 1 in which it can be seen the artificial hand of the present invention comprises a thumb 1 with an actuating lever 2, a fore finger 3 with a main phalanx 4, a middle finger 5 with a main phalanx 6, a ring finger 7 and a little finger 8. To provide a reliable and stable finger-pinch grasp, the main phalanges 4 and 6 of the fore finger 3 and the middle finger 5, respectively are dead-fixed to each other to form a single cluster.

The ring finger 7 and the little finger 8 are interconnected through a friction coupling 9 provided with a positive stop 10 to restrict the degree of extension of the little finger 8 with respect to the ring finger 7. To this end, the positive stop 10 is free to travel along an arcuate recess in the wall of the friction coupling 9.

The ring finger 7, in turn, is connected to the main phalanges 6 and 4 of the middle finger 5 and the fore finger 3, respectively through a friction coupling 11 provided with a positive stop 12 to restrict the degree of extension of the ring finger 7 with respect to the middle finger 5 and the fore finger 3.

A reversible electric drive 13 is located in the metacarpal portion of the artificial hand, and said drive comprises a D.C. reversible electric motor 14, an elastic-jaw coupling 15, two pairs of helical gears 16 and a screw pair including a screw 17 and a nut 18 adapted to reciprocate along a guideway 19.

The elastic-jaw coupling 15 enables discrete rotary motions from the shaft of the motor 14 to be pulsewise imparted to the grasping actuator of the artificial hand, whereby the grasping force thereof is increased due to a few extra pulses delivered and the object to be grasped is thus reliably gripped.

The nut 18 is connected to the actuating lever 2 of the thumb 1 through a kinematic couple 20. One of the members of the kinematic couple 20 is a spherical head 21 while the other is a socket 22 with a lengthwise slot (not shown) enabling the spherical head 21 to swivel and travel longitudinally. Thus, either of the members of the kinematic couple 20 is capable of both rotating and travelling with respect to the other member.

Fixed in the artificial hand is a guide stem 23 along which a slide block 24 reciprocates, with block being mechanically interlinked through rods 25 and 26 with the fore finger 3 and the middle finger 5. Motion is imparted from a pushrod 27 of the actuating lever 2 at a definite phase of finger extension through a pressure strip 29 rocking about a pivot pin 28 and adapted to act upon a stepless lock 30 which, in turn, transmits motion to the slide block 24.

A clearance "A" is left between the pressure strip 29 and the pushrod 27 to ensure that the mechanical linkage interconnecting the electric drive 13 with the clustered main phalanges 4 and 6 of the fore finger 3 and the middle finger 5 is a unidirectional (non-reversible) one capable of transmitting motion from the electric drive 13 to the pressure strip 29 only at a definite stage of finger extension. The lock 30 to ensure against extension of the fore finger 3 and the middle finger 5 from any external force, is essentially a wedging plate with a hole through which the guide stem 23 may pass. The lock 30 is movably mounted on the slide block 24 at a point removed from the guide stem 23 at a distance enabling it to be made askew and self-wedged with respect to the fixed guide stem 23. To this end, the plate of the lock 30 with its edge is loosely mounted in a slot "B" at a clearance allowing the lock 30 to be made askew and traverse crosswise with respect to the slide block 24.

The lock 30 is actuated by a spring 31 with respect to the slide block 24 in the direction of its self-wedging.

The slide block 24 is traversable in the direction of extension of the fore finger 3 and the middle finger 5 via a spring 32 having one end connected to the body of the artificial hand and the other end connected to the slide block 24.

To provide a convenient changing from a finger-pinch grasp to a fist grasp and vice versa, use is made of an automatic stop lock to fix the fore finger 3 and the middle finger 5 in the position corresponding to the finger-pinch grasp. The stop lock is essentially a rocking lever 34 articulated to the artificial hand through a pivot pin 33 and connected to a throw-over spring 35 that holds said lever 34 in its extreme positions, with said lever having arms 36 and 37 adapted to interact with corresponding abutments 38 and 39 of the slide block 24.

To effect a lateral or fist-lateral grasp the thumb 1 must be shifted in opposition to in the case of a finger-pinch grasp, into the position of retraction, in which it is capable, while flexing, of approximating the latero-distal surface of the fore finger 3. To provide this, provision is made in the artificial hand for a two-position mechanism 40 for a passive shifting of the thumb 1 into either of said two positions. The mechanism 40 turns the thumb 1 about a pivot pin 41 which is square with a pivot pin 42 around which the thumb 1 is to turn when flexing or expanding.

The mechanism 40 incorporates a segment 43 provided with teeth or holes and a lock which is defined by

a spring latch 44 capable of interacting with the segment 43.

The thumb 1 is shifted from one position into the other by pressing it against a table or any other suitable object.

The artificial hand functions as follows:

The D.C. reversible electric motor 14 (FIG. 1) fed from a storage battery (not shown) is switched on by control signals which are essentially bio-electrical potentials produced by two truncated muscles of the invalid.

The control signals first are delivered to the electronic control unit in which they are appropriately amplified and converted into a form suitable for a key-or proportional-control of the electric motor 14.

Rotation from the shaft of the electric motor 14 is imparted via the elastic-jaw coupling 15 and the two pairs of helical gears 16 to the screw 17. Reverse rotation of the screw 17 is converted into a reciprocating motion of the nut 18 of the screw pair. The nut 18 transmits rocking motion through the kinematic couple 20 having two degrees of freedom, to the actuating lever 2 interconnected with the thumb 1 and to the pushrod positively locked-in with the actuating lever 2.

The above afore-described method, due to the provision of a constant mechanical linkage interconnecting the electric motor 14 and the thumb 1, enables the thumb to flex or extend. The other four digits do not have motion imparted from the electric motor 14 until the pushrod 27 becomes engaged with the pressure strip 29 and starts actuating the strip 29. Hence, a relative geometric, kinematic and mechanical independency of the thumb 1 from the other digits is attained which is an indispensable condition for the formation of the kinds of grasp.

In case of the finger-pinch grasp, the fore finger 3 and the middle finger 5 are not flexed farther than to form a finger-pinch grasp. This is achieved due to the provision of an automatic stop lock to fix the fore finger 3 and the middle finger 5 in that position. With this kind of grasp, the rocking lever 34 of the stop lock assumes the position, in which the fore finger 3 and the middle finger 5 are free to flex only until the abutment 38 of the slide block 24 butts against the arm 36 of the rocking lever 34.

Said position, in which the abutment 38 butts against the arm 36 corresponds exactly to the position assumed by the fore finger 3 and the middle finger 5 in the finger-pinch grasp.

Only the thumb 1 actively acts upon the object being grasped, with the entire output power of the electric drive 13 being totally imparted thereto.

The fore finger 3 and the middle finger 5 having the main phalanges 4 and 6, respectively, made as a single rigid cluster, offer resistance to said exertion from the thumb 1, thus forming a rigid barrier. This is attained due to the provision of the stepless lock 30 which prevents the abovementioned fingers from being extended under the effect of an external force.

Flexion of the fore finger 3 and the middle finger 5, as well as that of the ring finger 7 and the little finger 8 interconnected thereto through the friction couplings 11 and 9, until the contact with the object being grasped, is effected by virtue of the spring 32 which is recharged with potential energy (i.e., becomes wound up) during the second half of the extension procedure of the thumb 1 when the clearance "A" is taken up and the pushrod 27 relays motion to the pressure strip 29.

When the ring finger 7 and the little finger 8 frictionally interconnected with the cluster of the main phalanges 4 and 6 of the fore finger 3 and the middle finger 5 and with each other, assumes the position of flexion not exceeding the angle of flexion of the cluster of the main phalanges 4 and 6, the positive stops 10 and 12 fix the ring finger 7 and the little finger 8 in position, and both fingers form likewise a rigid barrier against extension. This enables one in, say, the first grasp of a stick to stably and reliably hold it with of the fingers of the artificial hand.

To release the object grasped by the fingers of the artificial hand, the invalid has to send a control signal to extend the fingers in response to which the shaft of the electric motor 14 starts rotating in a direction opposite to that which is effective in finger flexion.

If a rather small object has been grasped, extending motion at the first half-stage of the finger extension is imparted from the electric drive 13 solely to the thumb 1.

The possibility of manipulating with the thumb 1 alone at a definite stage of flexion or extension adds to convenience in holding small objects by a finger-pinch grasp and their releasing, helps to perform motions more exactly and to regulate the grasping force, as well as contributing to a more precise and delicate coordination of motions while performing minor motorial functions such as work with pincers, scissors, etc.

Said independent motion of the thumb 1 is attained due to the fact that a disengageable unidirectional (non-reversible) mechanical linkage is provided to connect the reversible electric drive 13 to the fingers opposing the thumb 1, in which the contact of the pushrod 27 with the rocking pressure strip 29 occurs only after the clearance "A" has been taken up by the pushrod 27.

Said contact is established as late as during the last half of the thumb 1 extension procedure when the pushrod 27 imparts motion to the pressure strip 29 thus urging it to turn around the pivot pin 28. The turn of the strip 29 causes the slide block 24 to travel along the guide stem 23 in the direction of finger extension which, in turn, acts through the rods 25 and 26 to cause the fore finger 3 and the middle finger 5 to extend.

This motion is preceded by the lock 30 having been unwedged which under the effect of the pressure strip 29 is turned and forced with its end face against that of the slide block 24 while becoming coaxial with the guide stem 23.

Concurrently with the slide block 24 travelling in the direction of finger extension, the spring 32 is wound up.

Thus, within the last half of the thumb 1 extension procedure all to the other four digits are extended accordingly, and this is accompanied by the winding up of the spring 32.

To bring the fingers from the position corresponding to the finger-pinch grasp into the position corresponding to the fist grasp, one must allow the fore finger 3 and the middle finger 5 to flex completely while freely turning in the hinge joints thereof. To this end, the rocking lever 34 must assume the position in which the automatic stop lock of the fore finger 3 and the middle finger 5 is disengaged which occurs when the abutment 38 of the slide block 24 is free from resting against the

arm **36** of the rocking lever **34** and, consequently, the slide block is free to travel unrestrictedly in the direction of finger flexion until the first grasp is made complete.

Disengagement of the automatic stop lock of the fore finger **3** and the middle finger **5** is accomplished due to the fact that, prior to making a fist grasp, the invalid has to completely extend the fingers of the artificial hand.

Automatic changing over from the position of the fingers corresponding the finger-pinch grasp to that of fist grasp and vice versa, is effected as follows:

With the fingers extended completely, the abutment **39** of the slide block **24** presses upon the arm **37** of the rocking lever **34,** as is shown in FIG. **2,** causing the latter to turn with respect to the pivot pin **33** and bringing the arm **36** out of the position in which engages, as a result of a further extension of fingers, the abutment **38** of the slide block **24** and fix the fore finger **3** (FIG. **1**) and the middle finger **5** in the position of the finger-pinch grasp. This being the case, the throw-over spring **35** will assume the extreme position above the pivot pin **33** (FIG. **2**).

With the rocking lever **34** in this position, the artificial hand is ready for the fist grasp. Upon arriving, a control signal for grasping the spring **32** FIG. **1**) will cause a complete flexion of the fore finger **3** and the middle finger **5** to make a fist or to come into contact with the object being grasped.

While the fore finger **3** and the middle finger **5** are being flexed just after they have passed beyond the position of the finger-pinch grasp, the abutment **38** presses upon the arm **37** (FIG. **3**) of the rocking lever **34** urging the latter to turn around its pivot pin and to bring the arm **36** close to the outer surface of the abutment **38.** As a result, the throwover spring **35** will assume the position beneath the pivot pin **33.**

During the subsequent extension of the fore finger **3** and the middle finger **5** just after they have passed beyond the position of the finger-pinch grasp, the arm **36** of the rocking lever **34** is actuated by the throw-over spring **35** to drop down onto surface **45** of the slide block **24** (FIG. **4**). As a result, the artificial hand gets ready for flexing the fingers to make a pinch-grasp. With the slide block **24** (FIG. **5**) travelling backwards in the direction of finger flexion, the abutment **38** of the slide block **24** will butt against the arm **36** of the rocking lever **34** with the result that the movement of the fore finger **3** (FIG. **1**) and the middle finger **5** will discontinue in the position of the finger-pinch grasp.

In the case where a fist grasp is required instead of the finger-pinch grasp, one must, as stated above, preliminarily extend the fingers completely.

To make a lateral grasp, the thumb **1** must be shifted from opposition into the position of retraction by pressing the thumb against any suitable object or against the other hand of the invalid, with the thumb passive shifting mechanism **40** being provided for this purpose. When in either of the aforementioned positions, the thumb **1** is held by the spring latch **44.** In the lateral grasp, the lock to fix the middle and fore fingers in the position of a finger-pinch grasp remains engaged. As a rule, the movement of only the thumb **1** is employed, with the fore finger **3** remaining fixed in the position of a finger-pinch grasp. This adds the convenience of the lateral grasp, wherein the object is gripped in between the laterodistal surface of the fixed fore finger **3** and the thumb **1** brought close thereto.

When making a fist-lateral grasp as, say, in the case of grasping the grips of various tools, the lock to fix the fore and middle fingers in the position of a finger-pinch grasp is disengaged due to the preliminary complete extension of the fingers. With this kind of grasp, the thumb **1** assumes the position as in the case of a lateral grasp, while the other fingers are in the position of a fist grasp.

Since no provision is made for a constant mechanical linkage between the thumb **1** and the cluster of the fore finger **3** and the middle finger **5** and due to the presence of a friction coupling connecting the ring finger **7** and the little finger **8** to each other and to the middle finger **5,** the fingers are capable of adapting to the shape of the object being grasped.

The friction couplings **9** and **11** ensure that the ring finger **7** and the little finger **8** follow the fore finger **3** and the middle finger **5** when the latter two fingers are flexed or extended. At the same time, the friction couplings **9** and **11** enable a preliminary passive setting of the ring finger **7** and the little finger **8** to a most convenient, functionally advantageous and desirable (from the aesthetic point of view) position, as well as allow said fingers to extend to some degree with respect to the middle finger **5** when grasping a relatively large-sized object, so as to adapt to the configuration thereof.

The present artificial hand is favorably comparable with the known artificial hands due to a combination of high functional characteristics with a simple and reliable construction, an easy and convenient control of motions performed by the fingers of an artificial hand, in response to only two control signals, say, bioelectrical potentials produced by two truncated muscles. The artificial hand features a small size for its mechanisms thus allowing all the mechanisms, the drive inclusive, to be accommodated in the metacarpal portion thereof.

Among the functional features of the present artificial hand, it is worthwhile to mention the possibility of making an exact, reliable and stable finger-pinch grasp, as well as fist, lateral and fist-lateral grasps. This is accompanied by a reasonably high rate of finger approximation in any kind of grasp and a considerable grasping force with the low-power electric motor used.

Due to the possibility of retracting the thumb, a nearly flat palm can be formed when all of the fingers are extended, with this being instrumental in pressing and holding large-area flat objects therewith. The use of a low-power electric motor, as well as the high rate of clenching or opening of the hand call forth a rather low consumption of electric power and, consequently, make it possible to employ low-capacity storage batteries.

When the present artificial hand is controlled bioelectrically, the delivery of bio-electrical signals lasts a short time due to the high rate of clenching and opening of the hand, whereby the control of the motions performed by the fingers of the artificial hand proves to be indefatigable.

What is claimed is:

1. An artificial hand for upper extremity prosthesis, comprising: a frame; a thumb pivotally attached to said frame; at least two fingers located opposite said thumb; said at least two fingers being pivotally attached to said

frame; an actuating lever connected to said thumb; a reversible electric drive mounted on said frame; said electric drive being kinematically coupled with said actuating lever of the thumb and interconnected through a disengageable unidirectional non-reversible mechanical linkage with at least one of said thumb-opposing fingers so that the positive effect exerted by said electric drive upon said thumb-opposing finger occurs only in the direction of extension thereof, a spring connected to said thumb-opposing finger to actuate said thumb-opposing finger in the direction of flexion thereof; and a lock connected to said thumb-opposing finger to ensure against extension of said thumb-opposing finger under any external force applied thereto.

2. The artificial hand as claimed in claim **1,** comprising a slide block connected to said thumb-opposing finger; at least one guideway for reciprocating motion of said slide block; said at least one guideway being secured on said frame; and a push rod fixed on said actuating lever of the thumb and adapted to interact with said slide block; said slide block and pushrod effecting said kinematic coupling of said electric drive with said thumb-opposing finger.

3. The artificial hand as claimed in claim **2,** wherein said lock preventing said finger from extending under an external force includes a movable wedging plate provided with a hole, and a guide stem attached to said frame and passing through said hole, said plate being movably mounted on said slide block at a point removed from said guide stem at a distance that enables said plate to be made askew and self-wedged with respect to said guide stem.

4. The artificial hand as claimed in claim **3,** wherein said guide-way of said slide block is essentially said guide stem of said plate.

5. The artificial hand as claimed in claim **3,** wherein said plate is spring-actuated with respect to said slide block in the direction of its self-wedging when said slide block travels in the direction of extension of said thumb-opposing finger.

6. The artificial hand as claimed in claim **3,** including a rocking pressure strip pivotally attached to said frame, one side of said pressure plate interacting with said push rod fixed on said actuating lever of the thumb, and its other side interacting with said self-wedging plate at a point that enables said pressure plate to be unwedged when motion is imparted from said pushrod to said slide block.

7. The artificial hand as claimed in claim **1,** including an automatic stop lock attached to said frame and coupled with said thumb-opposing fingers so as to restrict the movement of said thumb-opposing fingers in the position corresponding to a finger-pinch grasp.

8. The artificial hand as claimed in claim **2,** including an automatic stop lock attached to said frame and coupled with said thumb-opposing fingers so as to restrict the movement of said thumb-opposing fingers in the position corresponding to a finger-pinch grasp.

9. The artificial hand as claimed in claim **8,** wherein said automatic stop lock includes a rocking lever articulated to said frame, and a throw-over spring interconnected with said lever and adapted to fix the lever in its extreme positions, said lever having arms and said slide block having abutments adapted to interact with said arms of the lever.

10. The artificial hand as claimed in claim **9,** wherein one of said arms provided on said rocking lever serves to bring said lever from the extreme positions, while the other of said arms is to fix said slide block in the position of a finger-pinch grasp.

11. The artificial hand as claimed in claim **1,** including a forefinger; a middle finger; a ring finger; a little finger; said forefinger, middle finger, ring finger and little finger being said thumb-opposing fingers, rigidly interconnected main phalanges of said forefinger and middle finger; a friction coupling for connecting said main phalanges to said ring finger and little finger, a positive stop to restrict movement of said friction coupling, said stop serving to restrict the degree of extension of said ring finger and little finger with respect to said forefinger and middle finger, while said ring and little fingers are connected to said middle and forefingers via the friction coupling provided with the positive stop to restrict the degree of their extension with respect to said fore and middle fingers.

12. The artificial hand as claimed in claim **11,** including a friction coupling to interconnect the little and ring fingers, and said coupling being provided with a positive stop to restrict the degree of extension of the little finger with respect to the ring finger.

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