March 16, 1965 R. GLABISZEWSKI 3,173,151

POSITIVE GRIP PROSTHETIC HAND HAVING AUTOMATIC LOCKING MEANS

Filed July 6, 1962

FIG. 1

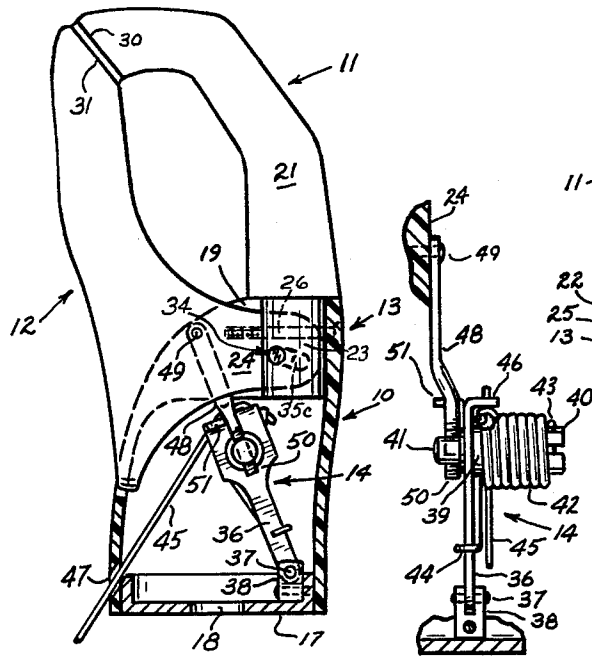


FIG. 2

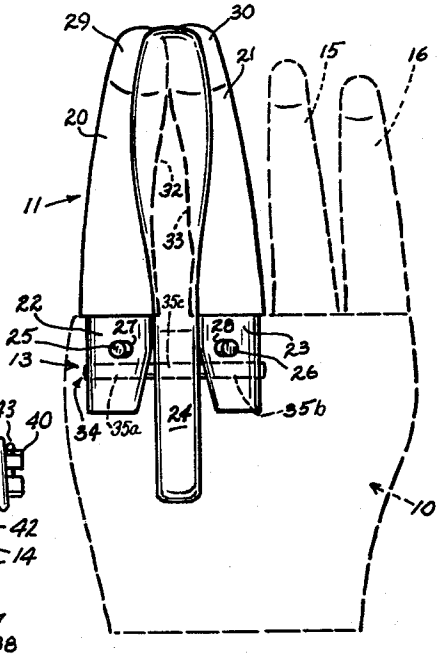


FIG. 5

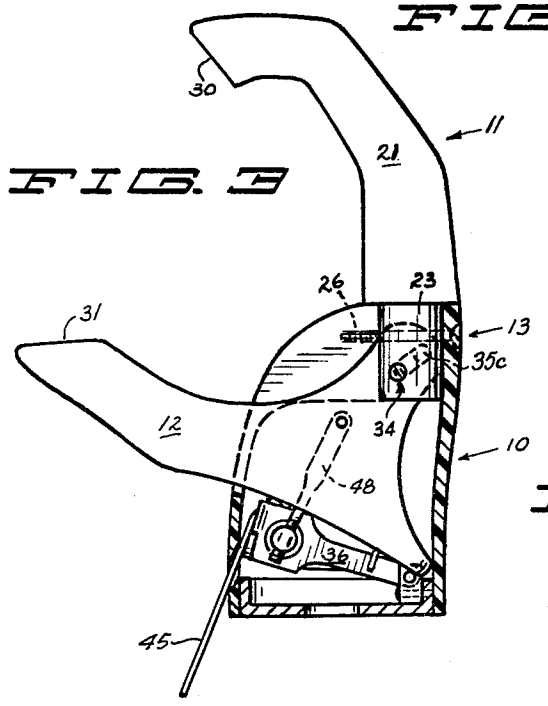


FIG. 3

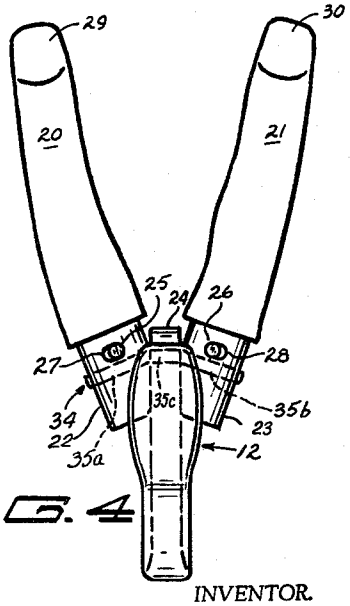


FIG. 4

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POSITIVE GRIP PROSTHETIC HAND HAVING AUTOMATIC LOCKING MEANS

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7 Claims. (Cl. 3—12.7)

This invention relates to prosthetic devices and more particularly to a cosmetically reproduced artificial hand having an improved gripping and locking function of the thumb and fingers.

It is an important object of the invention to provide a naturally appearing prosthetic hand of light weight and simple construction which is reliable in operation and which will perform a large variety of holding and gripping actions.

More specifically, it is an object to provide a three-point resilient gripping or holding action between the thumb, the index finger and the middle finger such that the points are in stable spread relation when the hand is open and the tips of the thumb and fingers are moved by means of a unique angulated pivot arrangement into mutual contact when the hand is closed.

Another object is to provide through a single actuator a simultaneous positive spreading and closing of the thumb and the two-finger members such that an article may be gripped between any two of the members or between all three as desired.

A further object is to provide a self-locking device which not only provides a biasing effect tending to close the thumb and finger members but also locks them when they are in closed position. Thus, extraordinary forces such as may be encountered by carrying heavy objects by handles will not accidentally counteract the biasing force and permit the handle to slip out of the user's prosthetic hand.

A still further object is to provide cooperating surfaces between the gripping portions of the thumb and fingers of such nature as will assist in holding and gripping articles but will not detract from the natural appearance and attitude of the prosthetic hand while being worn by an amputee.

These and other objects and advantages of my invention will more fully appear from the following description, made in connection with the accompanying drawing, wherein like reference characters refer to the same or similar parts throughout the several views and in which:

FIGURE 1 is a side elevation of a closed and locked prosthetic hand made in accordance with the invention, a portion of the housing being cut away to better show the internal construction thereof;

FIGURE 2 is a side view of the thumb and two-finger mechanism taken from the left in FIGURE 1, the remaining hand and finger construction being shown in dotted outline;

FIGURE 3 is a side elevational view similar to FIGURE 1 with the fingers and thumb held in open and unlocked position;

FIGURE 4 is a side view similar to that of FIGURE 2 but showing the thumb and two-finger mechanism in open position; and

FIGURE 5 is an enlarged detail view of the lever and spring assemblage.

With continued reference to the drawing, the invention comprises generally a hand housing **10**, a pair of actuable fingers **11**, a thumb **12**, a pivotal mounting structure for the fingers and thumb generally shown at **13** and an actuator assemblage **14** for closing, opening and locking the fingers and thumb.

The hand housing or casing **10** is also provided with cosmetic fingers **15** and **16** which in the present disclosure constitutes the ring finger and the little finger, respectively. Fingers **15** and **16** are non-functional but are naturally bent and are constructed of resilient material which will permit slight flexure to simulate the natural function of corresponding fingers in a true hand.

The hand housing or casing **10** may be constructed of fiber glass reinforced plastic material and all of the members covered with a soft but abrasion resistant flesh-colored material such as vinyl polyester.

The hand housing **10** has a wrist plate **17** fixed rearwardly thereof and may be provided with an opening **18** for securement to a prosthetic forearm (not shown).

At the forward portion of the hand housing **10** is an opening **19** which is adapted to receive the rear stump portions **22** and **23** of respective fingers **20** and **21** and **24** of the thumb **12**. Pivot pins **25** and **26** are fixedly mounted across the opening **19** about generally parallel axes. These pins **25**, **26** are secured to the hand housing **10** and pass respectively through somewhat enlarged openings **27** and **28** in the respective stump portions **22** and **23** of the fingers **20** and **21**. With this arrangement, the fingers can pivotally converge or diverge about the pivot pins **25** and **26** and at the same time can swivel to a limited degree within the respective openings **27** and **28**. The respective finger tips **29** and **30** of fingers **20** and **21** are adapted to cooperate with the thumb tip **31** when in closed position forming a three-point contact as shown in FIGURES 1 and 2. The respective sides **32** and **33** of fingers **20** and **21** also converge and articles may be gripped therebetween as well as against thumb **12**.

The rear or stump portion **24** of thumb **12** is provided with a pin **34** forming a pair of oppositely extending stub shafts **35***a*, **35***b* and an intermediate straight portion **35***c* disposed on a transverse axis with respect to the axes of the previously mentioned pins **25**, **26**. These stub shafts are mounted so as to be relatively angulated as shown in FIGURE 4, residing, however, in a plane generally parallel to the plane containing the pins **25**, **26** when the fingers **11** and the thumb **12** are converged together as shown in FIGURE 2. The stub shafts **35***a*, **35***b* in their depicted form may constitute a single shaft or pin **34** bent at each end of the portion **35***c* which is securely and rigidly fixed to the thumb **12** at the stump portion **24** as shown. The relative angulation between the stub shafts **35***a*, **35***b* may be varied somewhat but it has been found that a 135° angle is useful for the purpose intended. It will be observed that as the thumb **12** is swung downwardly to separate its tip **31** from the tips **29** and **30**, the fingers **11** constituting the index finger **20** and the middle finger **21** will diverge simultaneously with the thumb **12**. The angulation of the stub shafts **35***a*, **35***b* causes the forcible divergence of the fingers as shown particularly in FIGURE 4.

The means for actuating the thumb and fingers indicated generally at **14** may conveniently be an over-center knuckle joint or toggle actuator. This actuator has a first lever arm **36** which is pivoted at **37** to a bracket **38** secured to the wrist plate **17** shown in FIGURE 1. A capstan **39** is rotatably received in the arm **36** as shown in FIGURES 1, 3 and 5 and is provided with a castellated head **40** at one end and a transversely threaded end **41** extending through the arm to the opposite side thereof. A torsion spring **42** is wound about the capstan **39** with one end **43** anchored in the castellated head portion **40** and the other end **44** abutting the arm **36** as shown. Also secured to the arm **36** at its upper end is an actuating

cable 45, a bent bracket portion 46 serving for the anchor. The cable 45 extends through an opening 47 in the hand housing 10 for actuation by a shoulder harness or similar pulling mechanism.

A second arm 48 is also included in the actuator toggle mechanism 14 and this arm 48 is pivotally secured at 49 to the stump portion 24 of thumb 12. The arm 48 has a threaded lower end 50 which is received in the threaded extension 41 of the capstan 39. A bent bracket 51 serves as an abutment to prevent the spring pressed toggle actuator from moving appreciably past its locked position as shown in FIGURE 1. The torsion spring 42 is so arranged as to bias the toggle mechanism to the locked position which forces the thumb 12 convergently toward the index and middle fingers 29 and 30, respectively, the latter also converging simultaneously with the thumb. Spring 42 will maintain the fingers and thumb in closed relation with the tension controlled by the rotative position of the castellated head 40 prior to the insertion of the threaded end 50 of the second-mentioned arm 48.

Whenever a pulling force is exerted on the cable 47, the toggle actuator is moved from its locked position of FIGURE 1 to the unlocked position of FIGURE 3, the arms 36 and 48 also causing the thumb 12 to rotate and to turn the angulated stub shafts 35*a*, 35*b* of the pin 34 to simultaneously spread the index finger 20 and the middle finger 21 as previously described. The fingers 20 and 21 thus pivot or swivel about the pins 25, 26 with the consequence that they diverge from the "closed" position shown in FIGURE 2 to the "open" or separated position depicted in FIGURE 4. Of course, it is due to the continued diverging movement of the thumb 12 that causes the divergence of the fingers 20, 21; thus, the thumb 12 moves from its "closed" position illustrated in FIGURE 1 to the "open" position pictured in FIGURE 3. Stated somewhat differently, the tips of the thumb 12 and fingers 20, 21 are together in FIGURES 1 and 2 but are forced into a separated condition in FIGURES 3 and 4, the stub shafts 35*a*, 35*b* moving from a plane generally parallel to the plane containing the pins 25, 26 to a plane more nearly perpendicular to said first plane. Obviously, the planar relationship is not precise as this will depend on the degree or amount of thumb and finger motion. Through the agency of the spring 42, the thumb 12 and fingers 20, 21 will be automatically returned to their "closed" or converged condition when the cable 45 is released.

It will, of course, be understood that various changes may be made in the form, details, arrangements and proportions of the parts without departing from the scope of my invention as set forth in the appended claims.

What is claimed:

1. A prosthetic hand comprising:
(*a*) a hand housing,
(*b*) a pair of fingers swivelly mounted on said hand housing and adapted to move convergently and divergently thereon;
(*c*) a thumb having stub shafts fixedly secured thereto and extending in opposite directions along relatively angled axes into the inner ends of said fingers to provide a pivotal engagement with said fingers, and
(*d*) means for actuating the thumb and fingers between closed and open positions to provide said convergent and divergent movement.

2. A prosthetic and comprising:
(*a*) a hand housing,
(*b*) a pair of fingers swivelly mounted on said hand housing and adapted to move convergently and divergently thereon,
(*c*) a thumb pivoted mutually adjacent the inner ends of said fingers on an axis transverse to those axes about which said fingers are constrained to swivel and having actuating elements extending in generally opposite directions on axes relatively angulated to effect simultaneous convergence and divergence of said thumb with said fingers,

(*d*) means constantly biasing said fingers and said thumb toward convergence,
(*e*) actuator means adapted to overcome the force of bias and to cause simultaneous spreading and opening of said fingers and thumb, and
(*f*) locking means operable at the converged position of said fingers and said thumb to prevent spreading and opening thereof by external force.

3. A prosthetic hand comprising:
(*a*) a hand housing apertured at the fore portion thereof,
(*b*) a pair of pivot pins in spaced and generally parallel relation secured across the hand adjacent said apertured portion,
(*c*) an index finger mounted on one of said pivot pins,
(*d*) a middle finger mounted on the other of said pivot pins, said fingers being movable convergently and divergently,
(*e*) a bore formed through each of said fingers transversely of said pivot pins and in confronting angulated alignment,
(*f*) a thumb having a base portion mounted in said apertured portion of the hand housing,
(*g*) a pair of oppositely extending relatively angulated stub shafts fixed to said base portion of the thumb, said stub shafts being pivotally mounted in respective finger bores, and
(*h*) means biasing said thumb toward said fingers, said relatively angulated stub shafts upon swinging of said thumb causing mutual convergence and divergence of said fingers and thumb.

4. A prosthetic hand comprising:
(*a*) a hand housing having a wrist plate at the rear portion and being apertured at the fore portion thereof,
(*b*) a pair of pivot pins in spaced and generally parallel relation secured across the hand adjacent said apertured portion,
(*c*) an index finger mounted on one of said pivot pins,
(*d*) a middle finger mounted on the other of said pivot pins, said fingers being movable convergently and divergently,
(*e*) a bore formed through each of said fingers transversely of said pivot pins and in confronting angulated alignment,
(*f*) a thumb having a base portion mounted in said apertured portion of the hand housing,
(*g*) a pair of oppositely extending relatively angulated stub shafts fixed to said base portion of the thumb, said stub shafts being pivotally mounted in respective finger bores,
(*h*) means biasing said thumb toward said fingers, said relatively angulated stub shafts upon swinging of said thumb causing mutual convergence and divergence of said fingers and thumb, and
(*i*) a toggle actuator connecting said wrist plate and said thumb, said actuator being adapted to swing said thumb and to lock the fingers and thumb in their converged position.

5. A prosthetic hand comprising:
(*a*) a hand housing,
(*b*) a pair of fingers,
(*c*) means pivotally mounting said fingers on said hand housing for diverging and converging movement about generally parallel axes,
(*d*) a thumb cooperable with said fingers,
(*e*) means pivotally mounting said thumb for diverging and converging movement about an axis extending transversely with respect to said parallel axes; and
(*f*) means interconnecting said last-mentioned means and said fingers disposed along angled axes which intersect said transverse axis for actuating said fingers into a divergent relationship when said thumb is moved into a divergent relationship with respect to said fingers, and

(*g*) means for actuating said thumb into divergent and convergent positions with respect to said fingers.

6. A prosthetic hand comprising:

(*a*) a hand housing,

(*b*) a pair of fingers,

(*c*) means pivotally mounting said fingers on said hand housing for diverging and converging movement about generally parallel axes,

(*d*) a thumb cooperable with said fingers;

(*e*) a pin having an intermediate straight portion fixedly anchored within a portion of said thumb and extending along a transverse axis with respect to said parallel axes and said pin having straight end portions disposed at an angle with respect to said intermediate portion, said straight end portions being rotatably received within portions of said fingers near their said pivotal mounting means for effecting a divergent

movement of said fingers when said thumb is divergingly moved with respect to said fingers, and

(*f*) means for actuating said thumb into divergent and convergent positions with respect to said fingers.

7. A prosthetic hand in accordance with claim 6 in which said actuating means comprises:

(*a*) a toggle mechanism, for releasably locking said thumb in a convergent relationship with said fingers,

(*b*) whereby said fingers are automatically locked in a convergent relationship with each other.

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