Jan. 22, 1963 G. G. KUHN 3,074,075

ARTIFICIAL HAND FOR AMPUTEES

Filed April 20, 1959 2 Sheets-Sheet 1

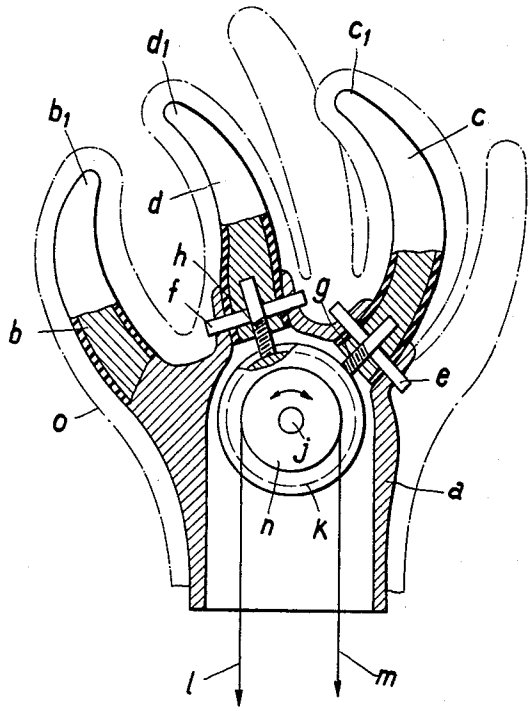


Fig. 1

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Filed April 20, 1959 2 Sheets-Sheet 2

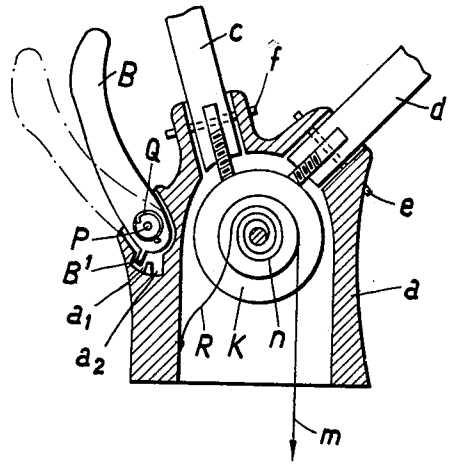


Fig. 3

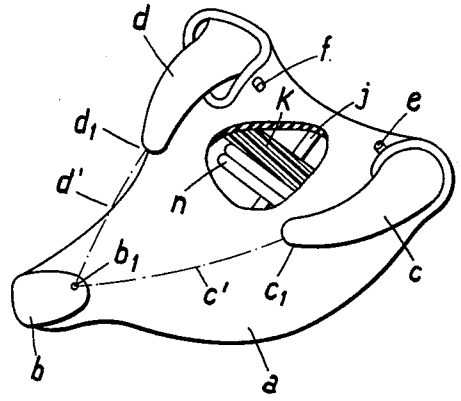


Fig. 2

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ARTIFICIAL HAND FOR AMPUTEES

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My present invention relates to an artificial hand adapted to be attached to, for example, the stump of a partially amputated arm for the purpose of functionally replacing as nearly as possible the natural hand.

Various types of artificial hands have been developed in recent years, particularly in the aftermath of the Second World War. These devices can generally be divided into two classes, passive and active ones. Passive hands are esthetically pleasing duplicates of the natural organ and generally include a full complement of fingers without, however, being capable of performing any mechanical operation more complex than the pushing and perhaps the pulling of objects. Active hands usually comprise a small number (two or three) of hook-shaped fingers, including an opposable "thumb," which can be moved relatively to one another through suitable means controlled by the user with his intact hand, or with some other part of his body, either directly or through an auxiliary source of electric or pneumatic power. With this latter type of device it is thus possible to carry out simple gripping operations, yet even the more elaborate systems so far designed have not been able to provide a gripping action between more than two fingers which would enable an amputee to hold, for example, a pencil as securely as can a person with healthy hands.

My invention, accordingly, has for its object the provision of an improved prosthetic device of the character described which, through the use of three relatively movable fingers, enables its user to hold a tool, a sheet of paper and other objects with a secure grip and to perform many tasks which the hand amputee could heretofore carry out only with difficulty or not at all.

A feature of my invention resides in the provision of an artificial hand with three fingers of which at least two are movable, about relatively inclined axes, in such manner that the tips of the three fingers meet when the movable fingers are simultaneously displaced in a hand-contracting direction. Thus, the tips of the movable fingers have orbits which lie in intersecting planes and cross at a point where the tip of the third finger, if stationary, is located. This third finger, hereinafter referred to as the thumb, may in turn also be movable, either in synchronism with the other fingers or independently therefrom; in the latter case I may provide a plurality of indexing positions into which the thumb may be selectively brought with the aid of the other hand or by contact with an external object such as a table.

A more particular feature of my invention, designed to provide a simple means of finger control and to insure positive maintenance of the fingers in their selected position of adjustment, involves the use of a common worm drive for the movable fingers. This worm drive, in turn, may be operated from without by means of two wires or, if preferred, by means of a single wire and a counteracting restoring spring.

The invention will be described in greater detail with reference to the accompanying drawing in which:

FIG. 1 is an elevational view, partly in section, of a prosthetic device embodying my invention;

FIG. 2 is a top plan view of the device shown in FIG. 1; and

FIG. 3 is a view similar to FIG. 1, showing a modification.

The artificial hand shown in FIGS. 1 and 2 comprises a hollow body *a* having integrally projecting therefrom a thumb *b*. Two other fingers, *c* and *d*, stand in opposition to the thumb *b* and are pivotally mounted on the body *a* by means of two relatively inclined pins *e* and *f*. The pins *e* and *f*, as best seen in FIG. 2, are so positioned that the tips c_1 and d_1 of fingers *c* and *d* are movable along orbits *c'* and *d'* (dot-dash lines) which lie in relatively inclined planes and converge at the tip b_1 of the stationary thumb *b*; in their open position shown in FIG. 2, these tips define the vertices of an approximately equilateral triangle. Each of the fingers *c* and *d* is rigid with a respective worm gear *g* and *h*, which may be only a sector gear as shown, meshing with a common worm *k* on a shaft *j* in the interior of body *a*. Because of the relative inclination of their axes *e* and *f*, the teeth of gears *g* and *h* should run at suitable angles relative to the respective gear axes. The worm *k* may be rotated with the aid of a wire which passes around a drum *n* on shaft *j* and has two ends *l*, *m* projecting from the body *a*.

It will be understood that the wire ends *l*, *m* may terminate at a suitable harness on the body of the wearer within reach of his other hand or so as to be operable by muscular contraction; they are, moreover, also representative of arrangements for selectively rotating the shaft *j* by automatic (e.g. electric or pneumatic) means.

FIG. 1 also illustrates, in dot-dash outline, an outer shell *o* which for cosmetic reasons can be slipped over the prosthetic device hereinabove described whenever the mechanical features of the latter are not required. The shell *o*, it will be noted, has three fingerlings to receive the thumb *b* and the fingers *c*, *d*, along with two dummy fingers serving to create the appearance of a complete hand.

In FIG. 3 I have shown a modified device in which the fingers *c* and *d* are movable in the housing *a* in the manner heretofore described while the thumb B is also given limited adjustability therein. Thumb B is swingable about a pivot stud P and is provided with a spur B' adapted to enter either of two recesses a_1, a_2 in housing *a*. To change the position of the thumb B it is merely necessary to move it axially on the stud P, against the force of a compression spring Q, so as to dislodge the spur B' from its recess; after resetting, this spur will drop into the other recess. This enables an adjustment of the size of the grasp, even though precise convergence between the three finger tips will not be possible in more than one of the several thumb positions. Essentially the same type of pincers movement will, however, occur in each of these positions.

FIG. 3 also illustrates a modification of the actuating mechanism for the worm *k*. In this figure only one extremity *m* of the operating wire is brought out of the housing *a*, the other extremity being fastened to the drum *n* within the housing. A restoring spring R is anchored to both the housing *a* and the drum *n*. This spring tends to withdraw the wire end *m* into the housing and to maintain the fingers *c* and *d* in a normal position corresponding to either the fully spread or the fully contracted hand. Although the spring R has been specifically illustrated as a spiral spring, it will be understood that the same may take a variety of forms including both contractile and expanding springs.

The pitch of worm *k* and worm gears *g*, *h* is such that this combination represents a self-locking system which keeps the movable fingers *c* and *d* rigid in whatever position has been selected by the control mechanism. As will be readily apparent, it would also be possible to control the thumb *b* by the same worm if such were desired. This and other modifications will be readily apparent to persons skilled in the art and are intended to be embraced in the scope of the invention as defined in the appended claims.

I claim:

1. A prosthetic device comprising a hollow body, a thumb projecting generally upwardly from said body, a shaft in said body extending generally at right angles to said thumb, a worm on said shaft, a pair of worm gears in mesh with said worm, said worm gears lying in mutually inclined planes which pass in generally radial direction of said shaft, a pair of fingers rigid with said worm gears, respectively, and hinged to said body for swinging motion about respective axes perpendicular to said planes, and means for simultaneously swinging said fingers between a first position remote from said thumb and a second position close to said thumb by rotating said worm, said fingers having tips which lie close to the tip of said thumb in said second position, the relative inclination of said planes being such that all of said tips define the vertices of an approximately equilateral triangle in said first position.

2. A prosthetic device comprising a hollow body, a thumb projecting generally upwardly from said body, indexing means on said body for selectively retaining said thumb in either of two fixed positions, a shaft in said body extending generally at right angles to said thumb, a worm on said shaft, a pair of worm gears in mesh with said worm, said worm gears lying in mutually inclined planes which pass in generally radial direction of said shaft, a pair of fingers rigid with said worm gears, respectively, and hinged to said body for swinging motion about respective axes perpendicular to said planes, and means for simultaneously swinging said fingers between a first position remote from said thumb and a second position close to said thumb by rotating said worm, said fingers having tips which in said second position lie close to the tip of said thumb with the latter in one of said fixed positions, the relative inclination of said planes being such that all of said tips define the vertices of an approximately equilateral triangle in said first position of said fingers and with said thumb in said one of said fixed positions.

References Cited in the file of this patent

UNITED STATES PATENTS

1,285,617	Caron	Nov. 26, 1918
2,553,827	Mason	May 22, 1951