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812,194, Apr. 1, 1969.

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[54] **SPRING-ACTUATED PROSTHETIC HAND WITH A**
FRICTIONAL LATCHING CLUTCH MEANS
2 Claims, 9 Drawing Figs.

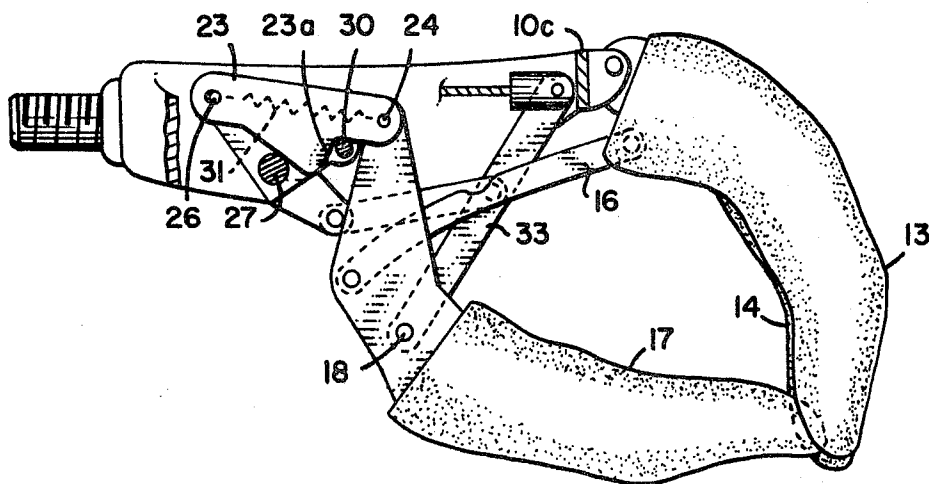
[52] U.S. Cl..... 3/12.7
[51] Int. Cl..... A61f 1/06
[50] Field of Search..... 3/12-12.8

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ABSTRACT: A prosthetic hand of lightweight construction having pivotally attached fingers including a forefinger, a middle finger proximal to the forefinger, and thumb which open and close simultaneously. The thumb is provided with an extension that is connected to a rotatable member which is spring biased to move the fingers into their closed position for gripping an object. The lever connecting the thumb extension to the rotatable member is provided with a frictional clutch surface that restrains moving of the fingers from their closed position, unless an excessive predetermined opening force is exerted on the fingers which could damage the hand. A cable-actuated lever is connected to the rotatable member for overcoming this restraining action and moving the fingers on their pivots to the open position to release their grip on said object. The frame holding these fingers and members is encased in a human-looking self-skin foam.



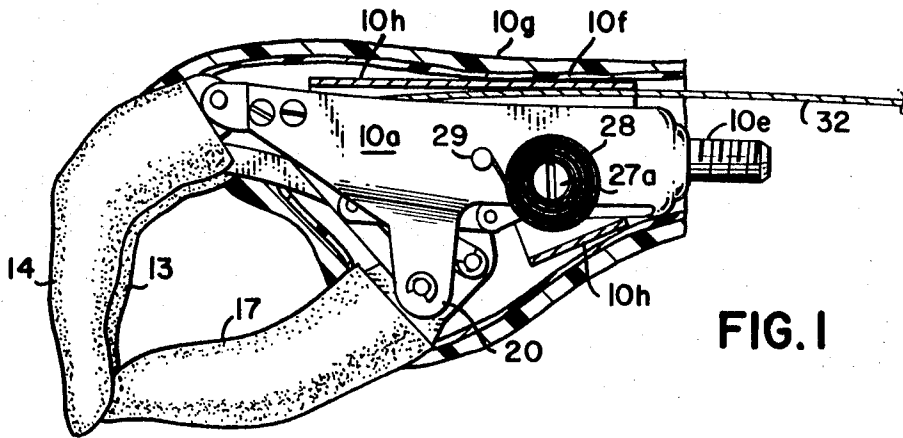


FIG. 1

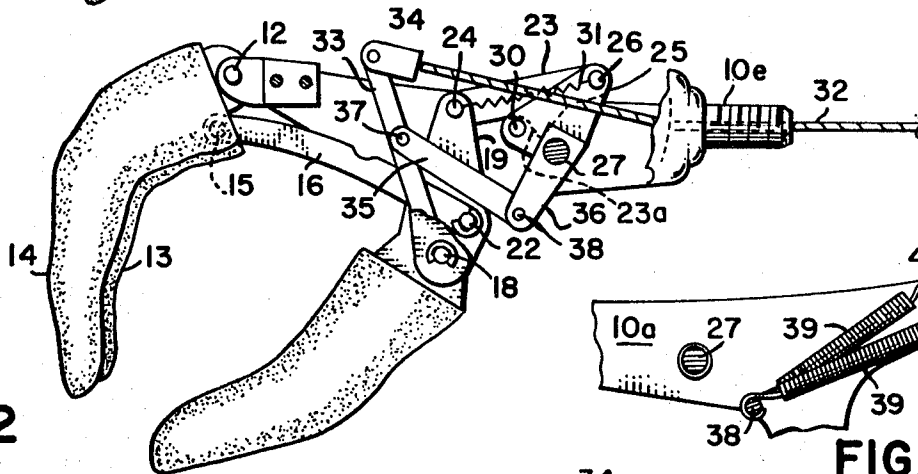


FIG. 2

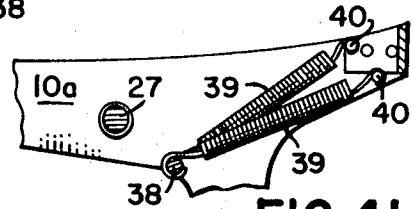


FIG. 4b

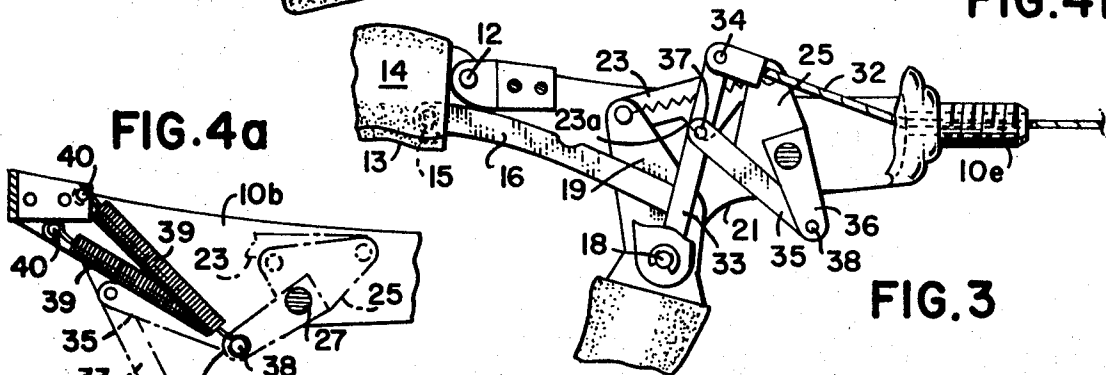


FIG. 3

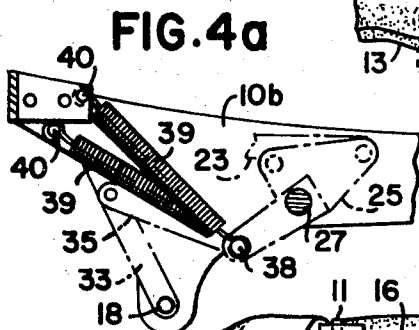


FIG. 4a

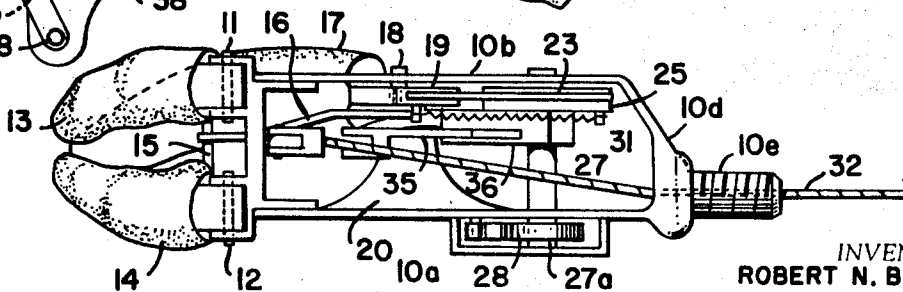


FIG. 4

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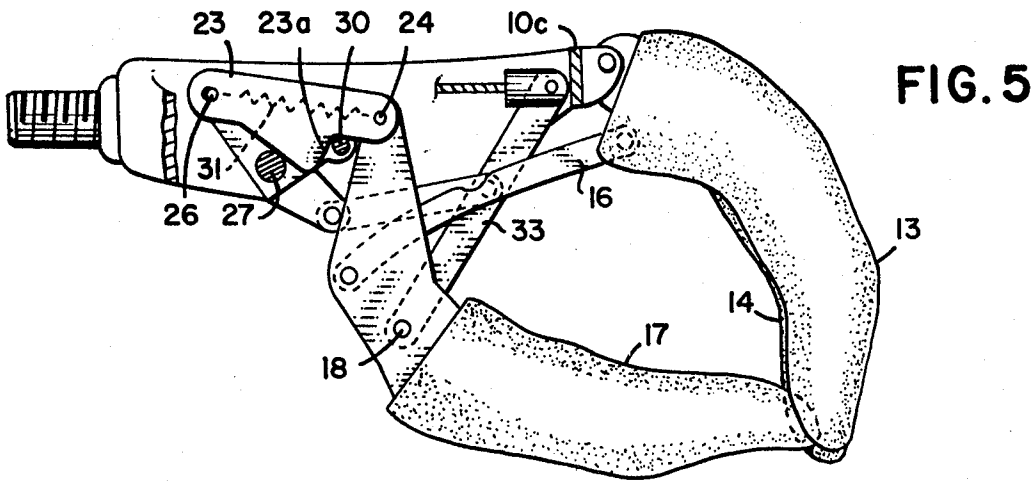


FIG. 5

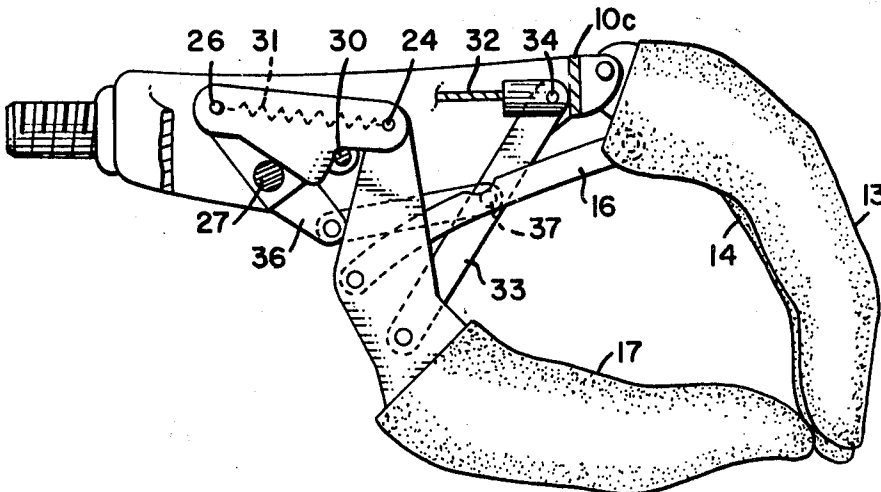


FIG. 6

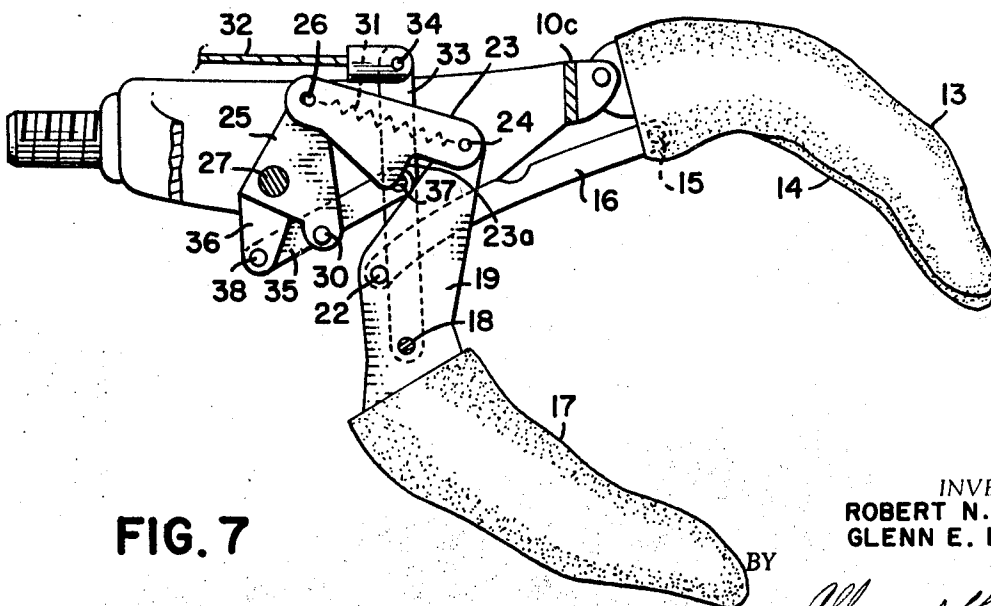


FIG. 7

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SPRING-ACTUATED PROSTHETIC HAND WITH A FRICTIONAL LATCHING CLUTCH MEANS

DESCRIPTION OF THE INVENTION

This application is a continuation-in-part of our U.S. Pat. application Ser. No. 812,194 filed Apr. 1, 1969, entitled "Spring Actuated Prosthetic Hand."

This invention relates to prosthetic hands, in general, and more particularly, to an improved and lightweight construction thereof.

An object of this invention is to provide an improved prosthetic hand constructed so that the wearer thereof may obtain a positive and firm grip on objects that he desires to handle.

Another object of this invention is to provide an improved prosthetic hand with a simple and efficient latching mechanism that functions to hold the fingers in their closed position.

Another object of this invention is to provide a prosthetic hand in which the movable fingers are operated by application of an external force having a ratio to the finger-gripping force of about 1½ to 1.

Another object of this invention is to provide a prosthetic hand in which the opening distance of the movable fingers is about twice the length of movement of the operating cable.

Another object of this invention is to provide an improved prosthetic hand in which the operating mechanism is of compact construction so that it may be positioned in a relatively small cavity formed in a plastic member having the outward appearance of a hand which is provided with two plastic fingers and which is also provided with suitable openings through which the pivotally mounted fingers and thumb of the prosthetic hand may project, the prosthetic hand simulating the appearance of a natural hand.

Other and further objects of this invention will be apparent to those skilled in the art to which it relates from the following specification, claims and drawings.

In accordance with this invention there is provided an improved prosthetic hand of compact durable lightweight construction arranged so that the operating mechanism thereof may be positioned in a cavity provided inside of a plastic member which is shaped to simulate a natural hand. This device is provided with a frame to which fingers, including a forefinger, middle finger, and a thumb are pivotally attached. The thumb is provided with an extension that extends inward into the frame and the inner end thereof is connected by a lever to a spring-urged rotatable member which functions to move the fingers into their closed position. This lever is provided with an arcuate surface that functions as a clutch engaging a pin carried by the rotatable member so that the finger-actuated mechanism is restrained when the fingers are in their closed position. The fingers may be released from this closed position by exerting pull on a cable which actuates a lever attached to the rotatable member whereby this member may be rotated against the tension of the spring. The rotatable member is adapted to rotate a very small amount before it starts to actuate the finger-operating lever and this small amount of rotation is sufficient to release the pin carried by the rotatable member from the arcuate surface described above.

Further details of this invention will be apparent to those skilled in the art to which it relates from the following specification, claims and drawings in which, briefly:

FIG. 1 is a side view of this device with the plastic casing thereof cut away and showing the thumb and forefinger thereof in closed position;

FIG. 2 is a side view of this device with the thumb and forefinger partially open and with part of the frame of the device broken away to show the relative positions of the finger-actuating mechanism;

FIG. 3 is a view similar to FIG. 2 with the thumb partially broken away and showing the fingers thereof in fully open position;

FIG. 4 is a top view of the frame and finger-actuating mechanism of this device;

FIGS. 4a and 4b are detail views of a different form of this invention employing two helical power springs instead of the spiral-type spring shown in FIGS. 1 and 4;

FIG. 5 is a view similar to FIG. 1 but with the hand rotated through a half a turn and with the frame of the hand partially broken away to show the finger-actuating levers;

FIG. 6 is a view similar to FIG. 5 except that this view shows the locked position of the latch of this prosthetic hand when pressure is being applied to the fingers by the weight of an object being lifted; and

FIG. 7 is a view showing this device with the fingers thereof fully open.

Referring to the drawing in detail, there is illustrated a prosthetic hand frame having sides 10a and 10b and also having a front 10c and a back 10d. The back 10d is provided with a shank 10e for attachment of the prosthetic hand to a member retained on the arm or shoulder of the human being. The front 10c is provided with projecting members which are adapted to receive the pivot pins 11 and 12 supporting the forefinger 13 and adjacent finger 14 on the frame. The frame 10 with the mechanism therein is enclosed in a plastic envelope 10f and this assembly is positioned in a plastic member 10g with the fingers attached to the frame projecting therefrom as shown in FIG. 1. Suitable plates 10h are attached to the sides 10a and 10b to prevent the envelope 10f from being pressed into the frame 10 when the urethane foam material 10g is being formed around the envelope and hand mechanism.

An actuating pin 15 is attached to the fingers 13 and 14 at points spaced inward from the pivoting pins 11 and 12 so that when pull is exerted on the lever 16 which has one end thereof connected to the pin 15, the fingers 13 and 14 will be moved toward their closed position with respect to the thumb 17. The thumb 17 is provided with an inwardly extending part or lever 19 and it is pivotally attached by the pin 18 to the projections 20 and 21 extending from the sides 10a and 10b, respectively, of the frame.

The lever 16 which has one end thereof connected to the pin 15 has the other end connected by the pin 22 to an intermediate part of the thumb extension 19. One end of a lever 23 is connected to the inner end part of the thumb extension 19 by the pivot pin 24 and the other end thereof is connected to the rotatable member 25 by the pivot pin 26. Lever 23 is provided with a short arcuate surface 23a and the center of this arcuate surface is near the center of the hole receiving the pin 26 or it may be at the far side of this hole. Rotatable member 25 is supported in the frame by the shaft 27 which is journaled in the sides 10a and 10b of the frame and the outer end 27a of which is connected to the inner end of the coil spring 28. The outer end of this coil spring is fixedly connected to the frame side 10a by the pin 29.

Spring 28 is wound so that it rotates shaft 27 and rotatable member 25 and provides the power for moving the fingers 13 and 14 and thumb 17 into their closed positions. Helical type springs 39 which are attached to the frame side 10b by pins 40 and to pin 38 of lever 36, may be used as the power springs instead of the spiral type spring 28. When these fingers are in their closed positions the levers of this mechanism assume the positions shown in FIG. 5 and the arcuate surface 23a provided to one side of the lever or linkage 23 is somewhat spaced from the pin 30 because of the tension exerted by the spring 31 which is stretched between pins 24 and 26. If pressure is applied between the forefinger 13 and thumb 17 the spring 31 yields and the arcuate surface 23a contacts pin 30 and forms a clutch therewith as shown in FIG. 6. The fingers 13, 14 and 17 are held by this clutch action in their closed position. This clutch action is enhanced by providing a predetermined small amount of play between the pin 26 and the linkage 23 so that applying pressure on any of the fingers tending to open the grip thereof allows the lever 23 to move and bring the arcuate surface 23a into firm engagement with the pin 30. This slight motion of the lever 23 is obtained against the tension of the

spring 31 which is provided between the pins 24 and 26 and which tends to take up the slack in the loose joint between the pin 26 and the lever 23 as described.

A cable 32 is provided for controlling the opening and closing of the fingers 13, 14 and 17. Exerting pull on the cable 32 causes the lever 33 which is connected to the cable 32 by the pin 34 to be rotated around the thumb pivot pin 18 to which the other end of the lever is connected. At the same time, levers 35 and 36 rotate the rotatable member 25 against the tension of the spring 28 or springs 39. For this purpose, one end of lever 35 is connected by pivot pin 37 to an intermediate part of the lever 33 and the other end of lever 35 is connected by pivot pin 38 to lever 36 which is attached to the rotatable member 25. It will be noted that one end of each of the springs 39 is attached to the pivot pin 38 which is firmly attached to the rocker lever 36 for this purpose. Thus, by exerting pull on the cable 32, rotatable member 25 is rotated against the tension of the spring 28 or springs 39 and fingers 13, 14 and 17 are moved apart through the operation of levers 23 and 16 and thumb extension 19.

In order to release the grip on the object pull is exerted on the cable 32 in opposition to the tension of the spring 28 on springs 39 and initial turning of the rotatable member 25 releases the pin 30 from the arcuate surface 23a. Exerting further pull on the cable 32 causes the mechanism to open the fingers 13, 14 and 17 as shown in FIGS. 2, 3 and 7.

An important feature of this prosthetic hand is that it may be used to lift objects such as a suitcase when the weight of the object is born by the fingers 13 and 14 without losing the grip thereon. However if the wearer of this prosthetic hand grips an object between the thumb 17 and the fingers 13 and 14 and if there is a possibility because of the motion of the object or excessive force applied thereto, of the prosthetic arm or hand being damaged or pulled off of the wearer, then the finger-locking mechanism described herein will release the grip if a force exceeding a certain predetermined value is applied tending to move the thumb away from the fingers 13 and 14.

While we have shown and described a preferred embodiment of the invention, it will be apparent to those skilled in the

art to which it relates that the invention is capable of variation and modification from the form shown so that the scope thereof should be limited only by the proper scope of the claims appended hereto.

What we claim is:

1. A prosthetic hand comprising a hollow frame, a plurality of fingers including a thumb, a forefinger, and a middle finger, means pivotally attaching said forefinger and middle finger to the forward end of said frame, means pivotally attaching said thumb to a side of said frame, said thumb having an extension extending into said hollow frame past the pivot thereof, rotatable means, a shaft supporting said rotatable means in said frame, a lever having one end thereof pivotally connected to the inner end of said thumb extension and having the other end thereof connected by a pivot pin to said rotatable means, a forefinger-actuating lever connected between said forefinger and said thumb extension, spring means, means connecting said spring means between said frame and said rotatable means for rotating said rotatable means and causing said first-mentioned lever to move said thumb and said forefinger to their closed position, frictional means engaging a surface of said first-mentioned lever restraining movement of said first-mentioned lever to prevent said thumb and said forefinger from being moved away from each other on said pivoting means thereof when they are in their closed positions so that they do not lose their grip on an object unless the object is such as to exert and excessive predetermined force which is sufficient to overcome said frictional restraining means thereby allowing the spreading of said thumb and said forefinger, said predetermined force being insufficient to damage the prosthetic hand, cable-actuated means for rotating said rotatable means against the tension of said spring to move said thumb and said forefinger away from each other.

2. A prosthetic hand as set forth in claim 1, further characterized in that said frictional restraining means comprises a pin attached to said rotatable means engaging said surface of said first-mentioned lever, said surface of said first-mentioned lever being an arcuate surface having a radius with its center located substantially at the center of said pivot pin.

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