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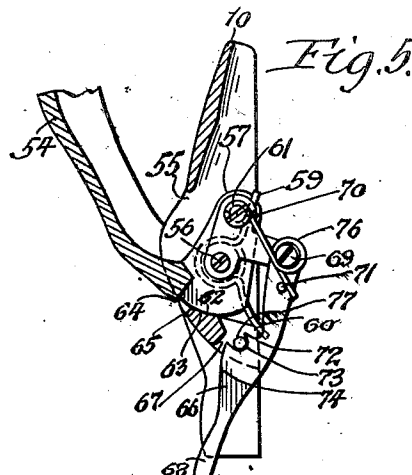
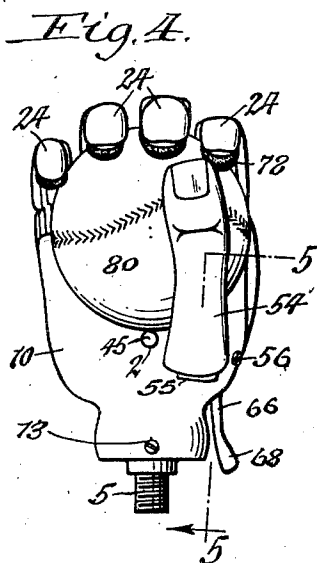
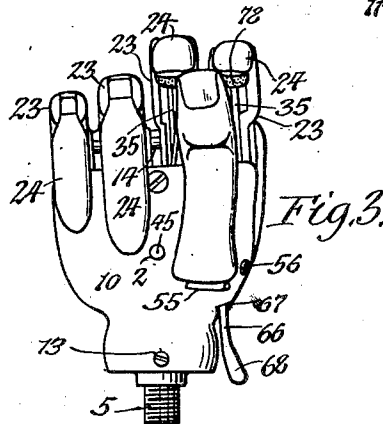
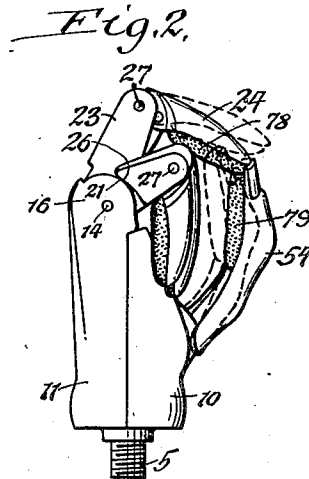
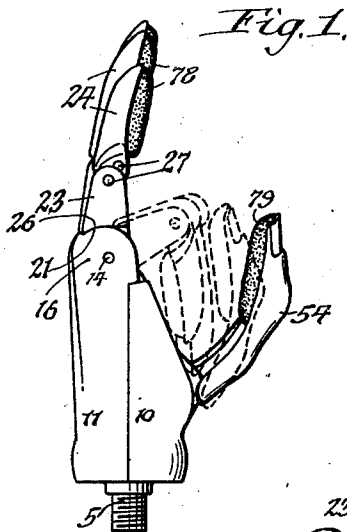
B. G. PECORELLA

2,364,313

ARTIFICIAL HAND

Filed Sept. 30, 1942

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

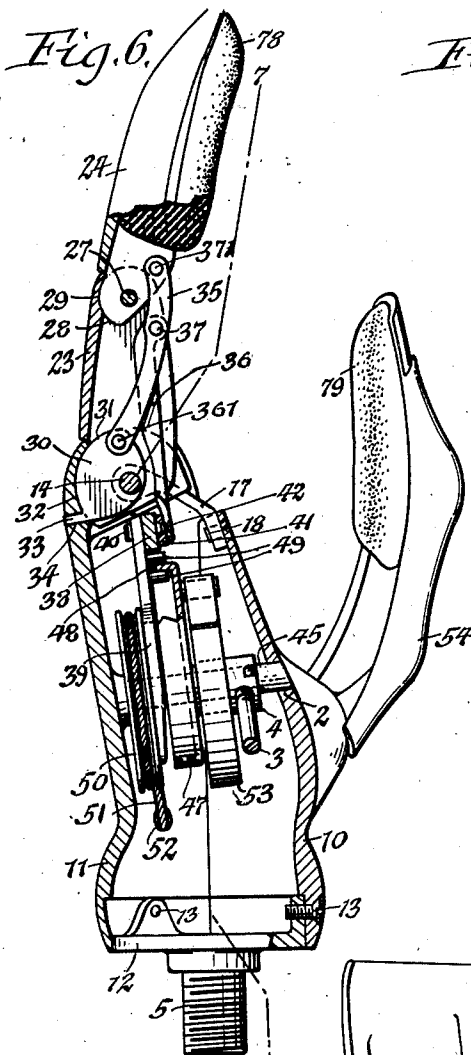


Fig. 9.

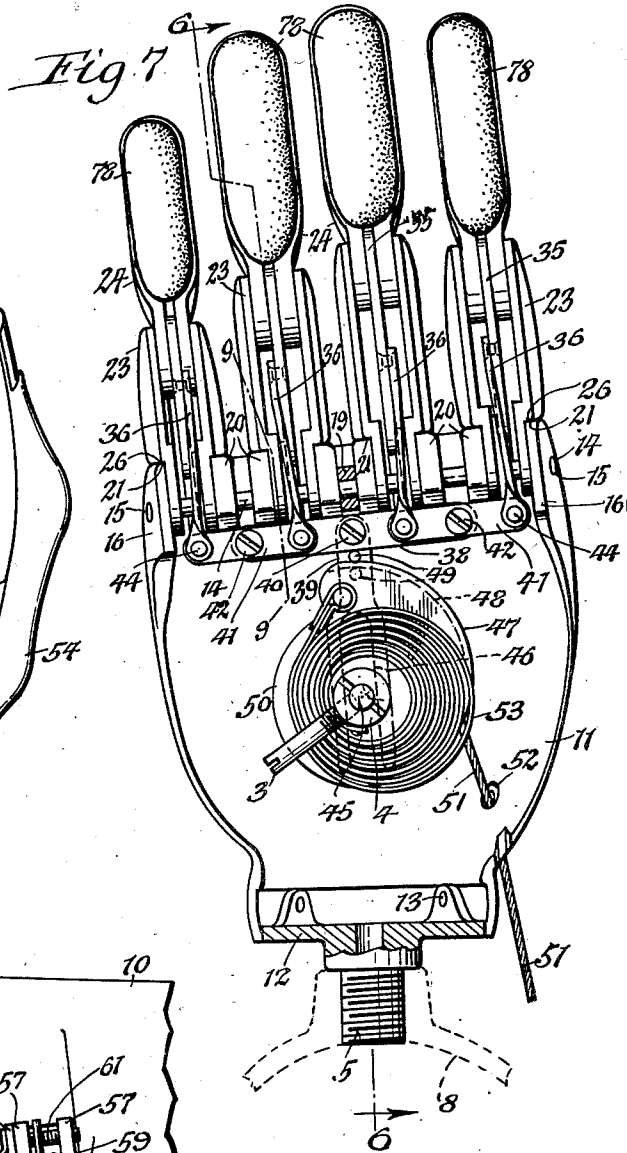
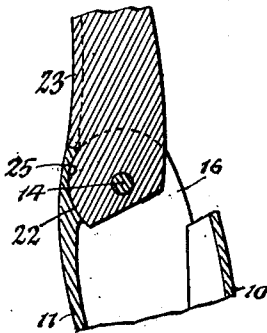
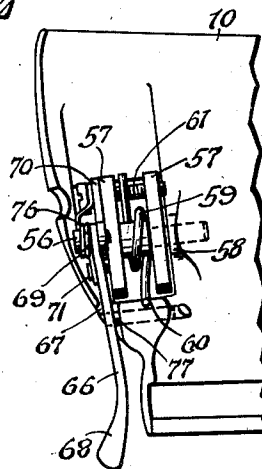


Fig. 8.



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UNITED STATES PATENT OFFICE

2,364,313

ARTIFICIAL HAND

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2 Claims. (Cl. 3—12)

This invention relates to an artificial limb of the general type shown in Letters Patent of the United States No. 1,792,183, granted February 10, 1931, to Alberto Pecorella.

The object of the present invention is to improve the means for mounting the articulated fingers and the thumb on the hand in an artificial limb of this character, and also to improve the means for operating the same and controlling their movement so as to enable the fingers and thumb to adapt themselves better to articles of different shape and size and obtain a more secure grip on the same.

In the accompanying drawings:

Fig. 1 is a side elevation of the artificial limb showing the fingers and the thumb in a fully opened position in full lines and the fingers and thumb represented by dotted lines in a position resembling a closed fist.

Fig. 2 is a similar view showing the thumb engaging its tip with the tips of the first and second fingers for producing a three point grip on small articles, such as pins or pencils.

Fig. 3 is a front elevation of the same.

Fig. 4 is a front elevation showing the manner in which the fingers and thumb of the hand grip a ball or similar globular article.

Fig. 5 is a fragmentary section, on an enlarged scale, taken on line 5—5 of Fig. 4 and showing the latch for holding the thumb in different open positions.

Fig. 6 is a side elevation, partly in section, of the hand with the fingers and thumb in a fully opened position, the section being taken on line 6—6, Fig. 7.

Fig. 7 is a rear elevation, partly in section, taken generally on line 7—7, Fig. 6.

Fig. 8 is a fragmentary inside elevation of the palm of the hand showing the latch whereby the thumb may be held in various positions.

Fig. 9 is a fragmentary longitudinal section, taken on line 9—9, Fig. 7.

In the following description similar characters of reference indicate like parts in the several figures of the drawings.

The palm of the hand constitutes the main support or frame of this artificial limb and this is made in the form of a casing or shell upon which the fingers and thumb are movably mounted and in which is enclosed some of the mechanism for operating the fingers and thumb.

In its preferred form the palm comprises hollow front and rear sections 10, 11 which form a chamber between them and the external surfaces of which simulate the shape of the front

and back sides of the palm of a human hand. These sections are detachably connected by means which may vary in construction but as shown in the drawings this is accomplished in part by connecting the lower ends of the palm sections with opposite sides of a circular wrist plate 12 by means of screws 13. Various means may be employed for connecting the wrist plate 12 to a support on the stump of an arm, such as a screw 5 projecting downwardly from the central part of said wrist plate and engaging a threaded socket 8 on the stump of the arm, as shown in Fig. 7. Additional means for connecting the palm sections comprise a pivot rod 14 arranged horizontally along the inner side of the upper part of the back section 11 and engaging with openings 15 in the forwardly turned bearing or supporting lugs 16 on the adjacent ends of this section, and a supporting bracket 17 arranged centrally between the upper parts of the palm sections and secured at its front end to the front section by a screw 18 and provided at its back end with an eye 19 which surrounds the central part of the rod.

Intermediate of the end supporting lugs 16 the rear palm section is provided with a plurality of intermediate bearing or supporting lugs 20, each of which is provided with an opening through which the pivot rod 14 passes. The several supporting lugs 16, 20 form pairs and the periphery of each of these supporting lugs is curved concentrically with the axis of the pivot rod 14, as shown at 21 in Figs. 1, 2, 6 and 9. The inner side of the rear palm section between each of these pairs is provided with a segmental bearing surface 22 which is curved concentrically with the axis of the pivot rod 14, as shown in Fig. 9.

Above the palm are arranged the four fingers of the hand each of which comprises a hollow inner section 23 pivotally mounted on the palm and a hollow outer section 24 pivotally connected with the inner section. The inner end of each inner finger section is arranged between a pair of the bearing lugs and is pivoted on that part of the pivot rod 14 extending from one of this pair of bearing lugs to the other. On its periphery each of the inner finger sections is provided with a segmental bearing face 25 which is curved concentrically with the axis about which this finger section turns on the pivot rod and on its opposite sides this finger section is provided with curved bearing surfaces or shoulders 26 which are concentric with the axis of the rod 14 and slide on the segmental bearing surfaces 21 of the

adjacent bearing lugs. By these means the inner finger sections are reliably held in their proper position both when in an open and in a closed position and therefore enable the same to obtain a good grip on the articles which are to be held.

The outer section of each finger has its inner end arranged within the outer end of one of the inner sections and pivoted thereto by a horizontal pin or pivot 27 and also provided with a segmental curved bearing surface 28 which is concentric with the axis of this pivotal connection and bears against a correspondingly curved bearing surface 29 on the adjacent inner side of the respective inner finger section, as shown in Fig. 6, thereby maintaining the outer finger section in its proper position relative to the companion inner finger section in the various positions into which the same are moved relative to one another.

In the use of this hand the inner finger sections are folded downwardly and unfolded upwardly relative to the palm and the outer finger sections are folded downwardly and unfolded upwardly relative to the palm and the inner finger sections for the purpose of adapting the finger sections to the shape of the articles which are to be grasped.

Improved means are provided whereby the folding and unfolding of the finger sections is effected, which means are constructed as follows:

The numerals 30 represent a plurality of anchors each of which is constructed in the form of an upright plate which is arranged within the inner part of one of the inner finger sections and has its inner part provided with an opening through which the adjacent part of the pivot rod 14 passes. The outer edge 31 of this anchoring plate is curved concentrically with the axis of the rod 14 and engages with a correspondingly curved seat 32 on the adjacent part of the palm. On the lower part of the anchor plate the same is provided with an outwardly projecting retaining pin 33 which projects into an opening 34 in the adjacent part of the palm, as shown in Fig. 6. These parts of the anchoring means can be easily fitted accurately and hold the anchoring plate reliably against rotation about the rod 14.

Upon turning each inner finger section downwardly toward the palm and upwardly away from the palm the companion outer finger section is moved in unison therewith toward and from the inner finger section and the palm by a link 35 which is pivoted at its lower end by a pin 361 to the upper part of the anchor plate 30 and also pivoted at its upper end by a pin 371 to the inner lower part of the companion upper finger section adjacent to its pivot pin 27, as shown in Fig. 6.

The numeral 36 represents a plurality of upright operating bars each of which is pivotally connected by a pin 37 with one of the shifting links 35 between its upper and lower ends, while the lower end of the operating bar is connected with an operating mechanism which is constructed in accordance with this invention. Upon longitudinally reciprocating each operating bar the sections of the respective finger associated therewith will be folded and unfolded.

This operating mechanism comprises a main equalizing lever 38 arranged horizontally within the upper part of the palm adjacent to the knuckles of the finger, a longitudinally movable yoke 39 which is arranged within the central part of the palm and to the upper part of which the main equalizing lever is pivoted by a screw

40 so that the bar can rock in a vertical plane, and a pair of auxiliary equalizing levers 41 pivoted by means of screws 42 to opposite ends of the main equalizing lever, as shown in Fig. 7. The opposite ends of each of the auxiliary equalizing levers are pivotally connected by screws 44 to the lower ends of two operating bars 36 of a pair of adjacent fingers, one of these auxiliary equalizing levers being connected with the operating bars of the first and second fingers and the other auxiliary equalizing lever being connected with the operating bars of the third and fourth fingers shown in Fig. 7.

Upon moving the yoke downwardly the main equalizing lever and the auxiliary equalizing levers are moved in unison therewith. If during this downward movement of these levers the several fingers meet with no obstruction the same are all pulled downwardly uniformly and the main and auxiliary equalizing levers remain in a parallel horizontal position relative to one another. If, however, one or another of these fingers during their downward or folding movement encounters an obstruction the further movement of the respective fingers in this direction will be arrested but those fingers which do not meet with any obstruction are free to continue their downward movement until they also are arrested by an obstruction or reach the limit of this movement. When the downward movement of the fingers is arrested at varying places the main lever rocks on the screw 40 and the auxiliary levers rock on the screws 42 into different angular positions relative to one another depending on the place where the downward movement of the several fingers is arrested.

By means of this compound rocking action of the main equalizing lever on the yoke and the individual rocking action of the auxiliary equalizing levers on the main equalizing lever, it is possible for each finger to be arrested in its downward or folding movement independently of the other fingers and thus enables the position of the fingers relative to each other to be varied widely and adapt them to articles which vary considerably in shape and take firm hold of the same.

The preferred form of the means for actuating the yoke 39 are constructed as follows:

The numeral 45 represents a stationary arbor or stud which is arranged horizontally in the palm perpendicular to rod 14 and below the same and is secured at its rear end to the rear palm section and arranged at its front end in an opening 2 in the front palm section but not connected with the latter, as shown in Fig. 6. The yoke 39 is guided on this arbor by providing the lower end of the yoke with a longitudinal slot 46 which receives the arbor, as shown by dotted lines in Fig. 7. The front end of this arbor is arranged close to or engages with the inner side of the central part of the front palm section so as to form a support for the latter when pressure is applied thereto when the hand grasps an article.

On this arbor is mounted a cam 47 which is rotatable about the axis thereof and which is provided on the periphery with a snail shaped rim 48 engaging on its inner and outer sides with rollers 49 on the front side of the yoke. Upon turning this cam clockwise the same moves the yoke outwardly and unfolds the fingers and upon turning the same anti-clockwise the yoke is moved inwardly and causes the fingers to be folded. The clockwise movement of the cam for unfolding the fingers is produced by means which include a drum or pulley 50 connected with the

rear side of the cam and a cord 51 having a part wound on said drum and one connected therewith while another part thereof passes through an opening 52 in the rear palm section and its opposite end is connected with a harness attached to the shoulder of the person using the artificial hand. The numeral 53 represents a spiral spring which has its outer end connected with said cam and its inner end connected with a collar 4 which is secured by a set screw 3 to said arbor. This spring tends constantly to rotate the cam and the drum connected with it in an anti-clockwise direction for folding said fingers. When it is desired to adjust the strength of the spring 53 the set screw is loosened, then the collar 4 is turned on the arbor in one direction or the other depending on whether the strength of this spring is to be increased or decreased and then the collar is again held stationary by tightening the screw 3. The screw 3 is made sufficiently long so that it will also serve as a handle for turning the collar and the arbor is provided on its periphery with a plurality of notches one or the other of which is engaged by the inner end of the screw 3 for holding the collar securely in place.

Normally the fingers are closed or folded toward the palm by the action of the closing spring 53 and the cam 47. When it is desired to use the hand the cord 51 is pulled outwardly whereby the cam unfolds the fingers and winds up the spring 53. Upon now releasing the pull on the cord this spring is permitted to turn the cam in the opposite direction and close the fingers on whatever is to be grasped.

It will be noted that the mechanism for operating the fingers is solely mounted on the rear section of the palm and that no movable parts of the same are mounted on the front section of the palm. By these means the operation of the fingers is in no wise dependent on the front palm section and thus permit of easily assembling the finger mechanism in an operative condition on the rear palm section and enable adjustment and repairs of the same to be made easily wholly independent of the front palm section.

On the front palm section adjacent to one of its lateral edges, a thumb 54 is movably mounted for cooperation with the palm and fingers to hold articles of various shapes. The lower end of this thumb projects rearwardly through an opening 55 in the front palm section and is pivotally connected therewith by a screw 56 which passes through two spaced ears 57 on the inner end of the thumb and into a lug 58 on the adjacent inner part of the front palm, as shown in Fig. 8.

Spring means are provided which tend to move the thumb outwardly or into an open position which means preferably comprise a coil spring 59 surrounding the pivot screw 56 between the thumb lugs 57 and engaging one of its ends with an abutment 60 on the front palm section while the other end of this spring engages with an abutment 61 consisting of a screw connecting the lug 57 above the pivot screw 56.

For the purpose of increasing the bearing surface of the thumb on the front palm section and thus strengthening the pivotal connection between these members, the lower part of the thumb is provided on its underside with a segmental face 62 which engages with a corresponding segmental face 63 on the adjacent part of the front palm section, both of these faces being curved concentrically with pivot 56 of the thumb.

The extent of opening movement of the thumb

is limited by a stop 64 formed on the lower part of the thumb and adapted to engage a stop 65 on the adjacent part of the front palm section, as shown in Fig. 5.

Latching means are provided for holding the thumb in a more or less closed or folded position which means in their preferred form, as shown in Figs. 5 and 8, are constructed as follows:

The numeral 66 represents a catch which extends through an opening 67 in the lower part of the front palm section adjacent to the thumb and provided externally of the palm with a handle 68 for manipulating the same. Within the palm the inner end of the catch is pivoted by a screw 69 on a bracket 70 which latter is secured to the adjacent thumb lug 57 partly by the pivot screw 56 which pivotally connects the thumb with the front palm section and partly by the screw 61 which connects the thumb lugs 57 at a distance from this pivot screw. On its front side the catch is provided with an inner locking notch 72, an intermediate locking notch 73, and an outer release face 74 which are arranged respectively different distances from the axis of the catch and one or the other of which is adapted to engage with a keeper 77 having preferably the form of a pin secured to the front palm section. This catch is yieldingly held in engagement with this keeper by a spring 76 which has a coil surrounding the pivot 69 of the catch and bears with one end against the fastening screw 71 and with its opposite end against the keeper or bearing pin 77 on the catch, as shown in Figs. 5 and 8.

When the thumb is in its outermost or fully open position its stop 64 engages with the stop 65 on the front palm section and the catch engages its release face 74 with the keeper. When adapting the space between the thumb and the palm to the article which is to be grasped the thumb is pushed inwardly until it engages this article and during this action the catch 66 moves outwardly more or less and engages one or the other of the locking notches 73 or 72 with the keeper 77, depending on the thickness of the article which is being grasped. During such inward movement of the thumb the spring 59 is increasingly strained and the spring 76 maintains the catch in engagement with the keeper for retaining a grip on the article which is being held. When it is desired to release the article from the grip between the thumb and the palm, the catch is disengaged from the keeper by pressing the handle 68 inwardly and when this occurs the spring 59 immediately moves the thumb into its outermost position and the catch into its innermost position.

In the use of this artificial hand the operator first unfolds the fingers and thumb, then pushes the thumb inward and engages its inner side with one side of the article to be grasped while the palm engages the opposite side of the same, and then the operator permits the fingers to relax and fold themselves more or less regularly around the side of said article opposite to the thumb, thereby obtaining a firm hold on the article regardless of its contour.

In order to produce a soft or cushioning engagement of the fingers and thumb with the articles to be grasped the opposing gripping ends of these members are provided respectively with rubber pads 78, 79, as shown in Figs. 1-4, 6 and 7.

It has been found that when the thumb and one of the fingers grasp an elongated article on transversely opposite sides thereof, such for example, as a pencil or a pin, that this article is liable to tilt or wobble. The present invention

therefore so mounts the thumb and fingers on the palm that the tip of the thumb when more or less closed will be arranged opposite the space between the tips of two of the fingers, in this case the first and second fingers, as shown in Figs. 2 and 3, thereby causing a three point engagement of the fingers and thumb with such an article and permitting the same to be securely held without liability of displacement.

For the purpose of grasping a ball 80, as shown in Fig. 4, or similar article, the fingers are first closed so as to yieldingly engage different parts of the same which are on a curved line and thus require the several fingers to fold varying degrees in accordance with the distance from the outermost position of the respective fingers and the place at which the same contacts the ball or the like, and then the thumb is forcibly engaged with the opposite side of the ball or the like and held locked in this position by the catch, after which this article may be carried about freely and under perfect control. When the artificial hand is not in use the thumb is left in its fully open or unfolded position, as shown by full lines in Fig. 1, and the fingers are yieldingly held by the contracting spring mechanism in a completely folded position, as shown by dotted lines in Fig. 1, so that the thumb and fingers at this time simulate a clenched fist.

Although the present disclosure represents a practical embodiment of these improvements, it is to be understood that this invention is not limited thereto but is intended to comprehend all

modifications within the scope of the appended claims.

I claim as my invention:

1. An artificial limb comprising a palm having front and rear sections, a pivot rod arranged on the inner side of said rear section and supported at its ends thereon, fingers pivoted on said rod, and a bracket secured to said front section and connected with the central part of said rod.
2. An artificial limb comprising a palm, a thumb pivoted on said palm, and means for yieldingly holding said thumb in an open position and locking the same in a closed position comprising a three armed bracket, a main pivot screw pivotally connecting one arm of said bracket and thumb to said palm, a latch adapted to engage a keeper on the palm, an auxiliary pivot screw which pivotally connects said latch with another arm of said bracket at a point remote from said main pivot screw, an abutment screw which connects still another arm of said bracket and thumb at a point remote from said main pivot screw and said auxiliary pivot screw, a spring for opening said thumb having a coil surrounding said main pivot screw and projecting ends on said coil which engage, respectively, with said abutment screw and the palm, and a spring for holding said latch against said keeper and having a coil surrounding said auxiliary pivot screw and projecting ends on said coil which engage, respectively, with said abutment screw and said latch.

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