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ROTOR BLADE FOLDING MECHANISM

Filed Aug. 6, 1957

3 Sheets-Sheet 1

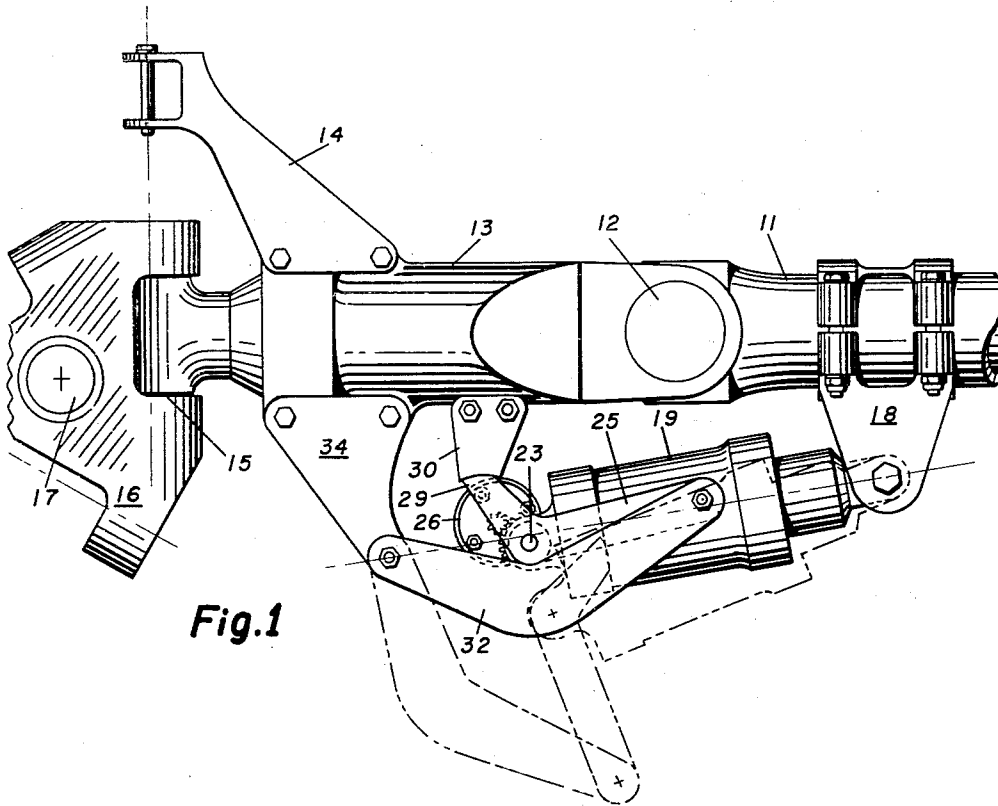


Fig. 1

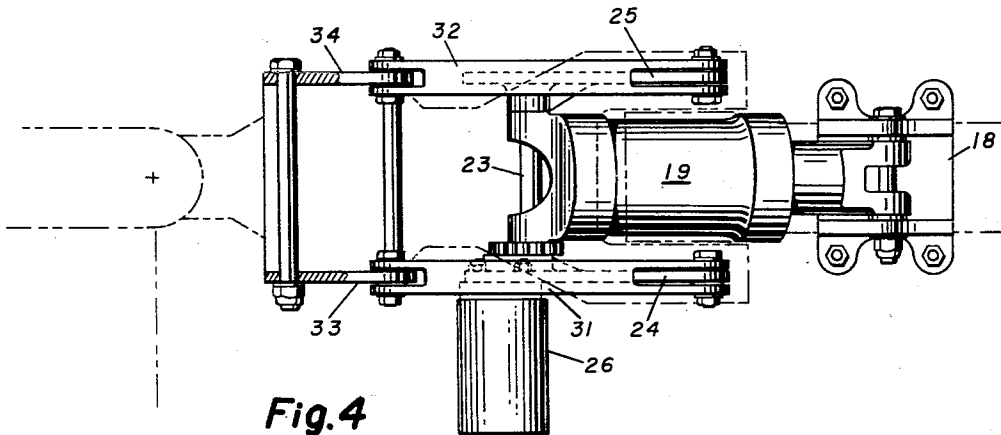


Fig. 4

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3 Sheets-Sheet 2

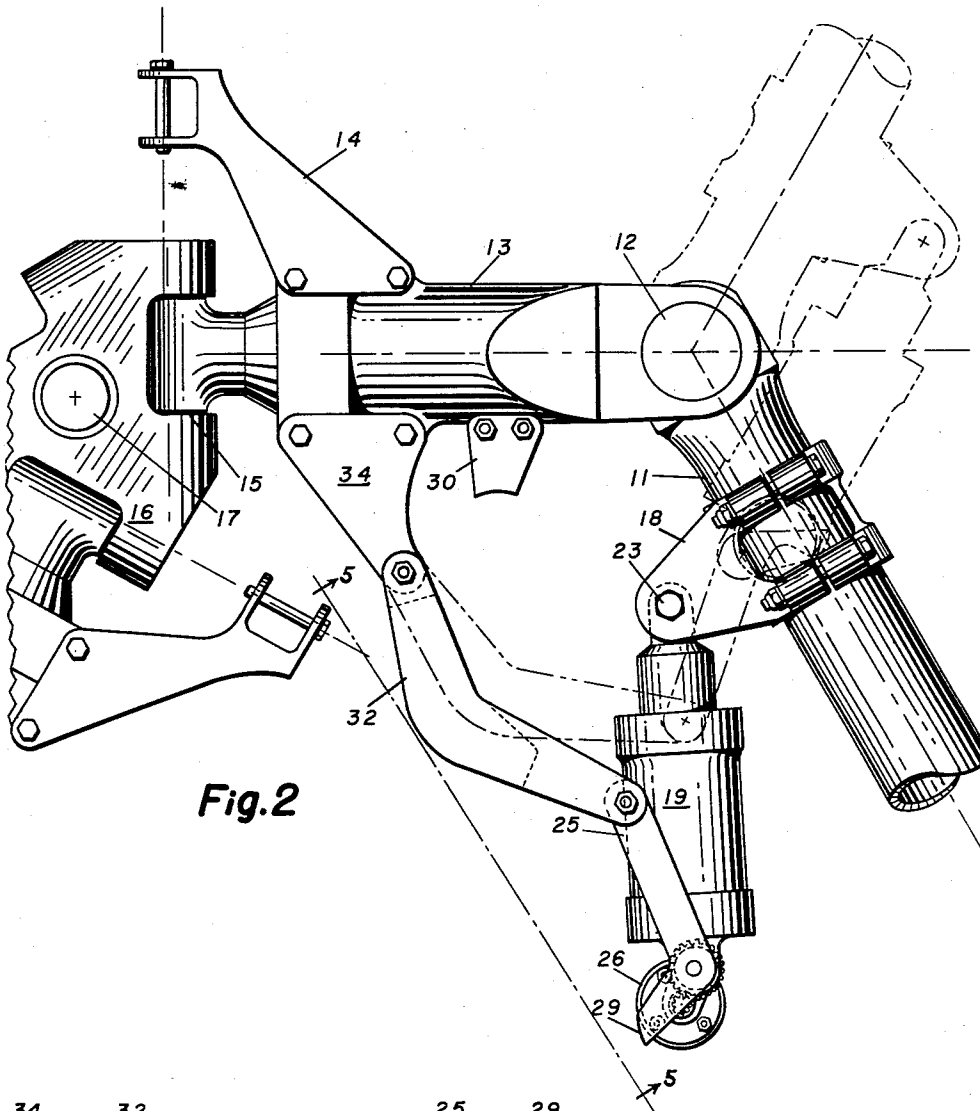


Fig. 2

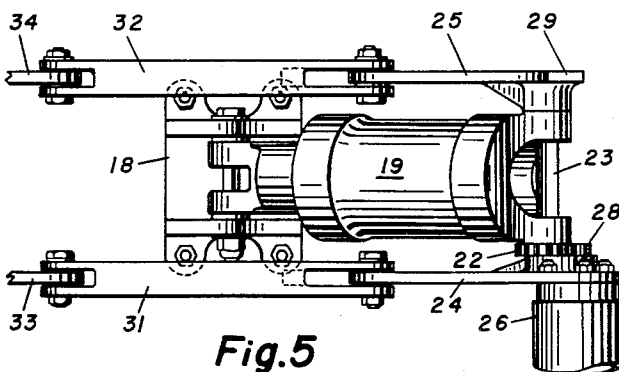


Fig. 5

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3 Sheets-Sheet 3

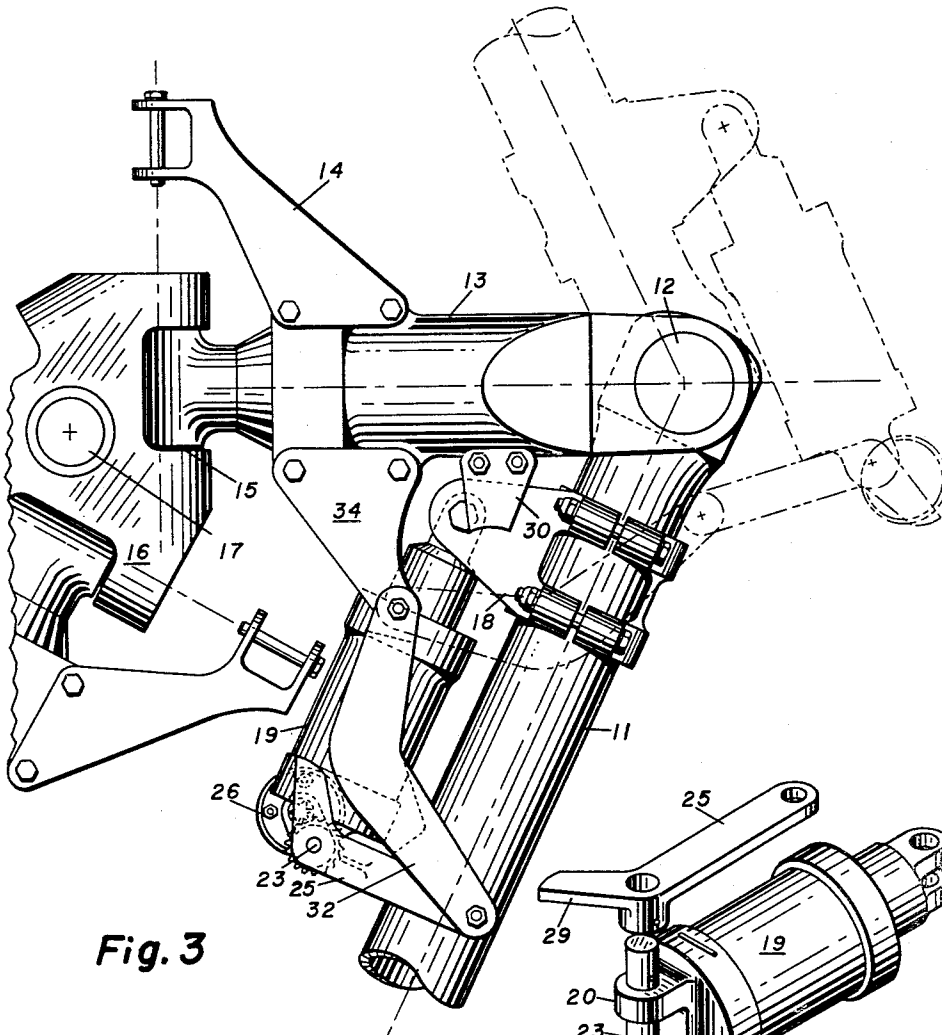
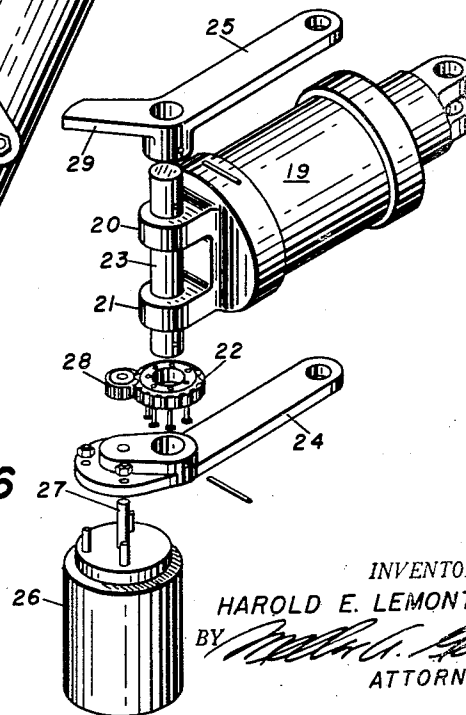


Fig. 6



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ROTOR BLADE FOLDING MECHANISM

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7 Claims. (Cl. 170—160.12)

This invention relates to rotary wing aircraft and more particularly to mechanism for folding the rotor blades thereof.

The principal object of this invention is to provide means for folding the blades about a substantially vertical axis and/or about their lead-lag pivot. It is a further object to provide folding mechanism which includes the lead-lag damper whereby folding is accomplished without disconnecting the lead-lag damper and without disconnecting the pitch control mechanism associated with the blades. It is a still further object to provide power means for actuating the folding mechanism whereby initial actuation thereof unlocks the folding mechanism and the blade may then be folded manually in either direction or continued operation of the power means actuates the folding mechanism to fold the blade in one direction.

Other objects and advantages will become apparent from the following description when read in conjunction with the accompanying drawings in which:

Fig. 1 is a plan view showing the blade in the unfolded position and showing in phantom the position of the folding mechanism in unlocked position;

Fig. 2 is a plan view showing in solid lines and in phantom respectively, the blade and folding mechanism in the partially folded position when being folded in one direction, and when being folded in the opposite direction;

Fig. 3 is a plan view showing in solid lines and in phantom, respectively, the blade and folding mechanism in folded position when folded in one direction, and when folded in the opposite direction;

Fig. 4 is a side elevation of the blade folding mechanism of Fig. 1;

Fig. 5 is a view taken along line 5—5 of Fig. 2 showing the blade folding mechanism; and

Fig. 6 is an exploded view of a portion of the blade folding mechanism.

As shown in the drawings, numeral 11 indicates the root end of a rotor blade which is mounted by means of the lead-lag pivot or vertical pin 12 to a pitch bearing member 13 provided with a pitch arm 14 which at its outer extremity is connected to pitch control linkage not shown. The pitch bearing member 13 is mounted by means of a horizontal pin 15 to the rotor hub 16 which is fixedly attached to and rotated by the vertical drive shaft 17.

A bifurcated bracket member 18 is clamped or otherwise secured to the root end of the blade and pivotally supports one end of a lead-lag damper 19. The other end of the damper is provided with ears 20 and 21, and as is more clearly shown in Fig. 6, the ear 21 has fixedly attached thereto a gear 22. A pivot pin 23 extends through holes in the ears 20 and 21 and the gear 22, and has attached at either end links 24 and 25. Link 24 is provided with an extension which forms a mounting plate for a reversible rotary actuator 26, preferably of the electrical type, and having a drive shaft 27 extending through the mounting plate and upon which is keyed or

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otherwise secured a drive gear 28 which engages the gear 22 fixedly attached to the damper. By such arrangement, operation of the actuator 26 causes rotation of the damper 19 relative to the links 24 and 25. Link 25 is provided with an extension 29 which when the mechanism is in the locked position shown in Fig. 1, is adapted to bear against an abutment plate 30 provided on the housing of the pitch bearing 13.

The other ends of links 24 and 25 are pivotally connected to links 31 and 32 respectively, which in turn are pivotally connected to bracket members 33 and 34 fixedly attached to the housing of the pitch bearing.

It will be noted that when the mechanism is in the locked position shown in Fig. 1, the pivotal connections between links 24 and 31 and links 25 and 32 are overcenter with respect to the pivotal connection of the damper to the bracket member 18 and the pivotal connections of the bracket members 33 and 34 to the respective links 31 and 32 whereby any compression or tension forces transmitted to the damper as a result of the lead-lag motion of the blade tends to force extension 29 more tightly against the abutment plate 30. This action may be more clearly understood by a description of the operation of the blade folding mechanism of the present invention from the partially folded position shown in Fig. 2 to the fully extended and locked position shown in Fig. 1. In order to accomplish this change in position the power actuator 26 is operated to drive link 25 counterclockwise with respect to the pivotal connection between link 25 and link 19 until the advancing edge in the direction of rotation of link 25 abuts the link 32 along the surface shown as a dotted line on the link 32 in Fig. 2. Continued operation of the actuator 26 driving link 25 counterclockwise with respect to link 19 will cause the pivotal connection between link 32 and link 25 to move in a counterclockwise direction since link 32 is caused to rotate about its pivotal connection with bracket member 34 as a result of the abutment of link 25 with link 32. This counterclockwise rotation is continued until extension 29 of link 25 contacts abutment plate 30 and at this extreme position the pivotal connection between link 32 and link 25 is in the overcenter position referred to above.

Operation of the actuator 26 is such as to rotate the damper 19 in a counterclockwise direction with respect to the links 24 and 25. Initial operation positions the linkage as shown in phantom in Fig. 1. When in this position, the linkage is unlocked and the blade may be manually folded in either direction to the positions shown in Fig. 3. However, continued operation of the actuator 26 continues to rotate the damper in a counterclockwise direction with respect to the links 24 and 25, whereby the linkage passes through the solid line position shown in Fig. 2 and finally to the solid line position shown in Fig. 3 wherein the blade is completely folded. Operation of the actuator 26 in the reverse direction causes clockwise rotation of the damper 19 relative to the links 24 and 25 and hence an unfolding of the blade from the solid line position shown in Fig. 3 to that shown in Fig. 1. Limit stops not shown may be provided for deenergizing the actuator 26 when the linkage has reached either of the extreme positions.

Although shown and described in what is believed to be the most practical and preferred embodiment, it is apparent that departures therefrom will suggest themselves to those skilled in the art and may be made without departing from the spirit and scope of the invention. I therefore do not wish to restrict myself to the particular form of construction illustrated and described, but desire to avail myself of all modifications that may fall within the scope of the appended claims.

Having thus described my invention, what I claim is:

1. In combination with a rotor blade having a fixed portion and a folding portion pivotally connected thereto, a blade folding mechanism comprising a first link pivotally connected to said folding portion, a second link pivotally connected to said fixed portion, and an intermediate link pivotally interconnecting said first and second links to form a three-link toggle combination operatively connected between said folding portion and said fixed portion, abutment means on said second link for engagement with said intermediate link and power means interacting between two of the links of said three-link toggle combination at their common pivotal connection for imparting motion to said links relative to each other, whereby said folding portion is pivotally moved relative to said fixed portion.

2. The combination of claim 1 in which the power means is fixedly attached to one of said links.

3. In combination with a rotor blade adapted for folding about a pivot joint, a blade folding mechanism comprising a first link pivotally connected to the blade at a point outboard of said pivot joint, a second link pivotally connected at a point inboard of said pivot joint, an intermediate link pivotally connected to said first and said second links to form therewith a three-link toggle connection disposed adjacent said pivot joint, actuator means carried by one of said links and adapted to position said toggle connection between locked and unlocked positions, and damper means contained within one of said links to restrain motion of said blade about said pivot joint when said toggle connection is in locked position.

4. In combination with a rotor blade comprising a fixed portion and a folding portion pivotally connected to said fixed portion, a first link pivotally connected to said folding portion, a second link pivotally connected to said fixed portion, an intermediate link pivotally connected to said first and said second links to form therewith a three-link toggle connection, abutment means provided on said fixed portion, and means provided on said intermediate link for engagement with said abutment means when said blade is in the unfolded position, said pivotal connection between said first link and said intermediate link being positioned, when said blade is in the unfolded position, over-center with respect to the pivotal connections between said first link and said folding portion and be-

tween said second link and said fixed portion, and abutment means on said second link for engagement with said intermediate link thereby limiting movement thereof, whereby said rotor blade is locked in unfolded position.

5. In combination with a rotor blade comprising a fixed portion and a folding portion pivotally connected thereto, a first link pivotally connected to said folding portion, a second link pivotally connected to said fixed portion, an intermediate link pivotally connected to said first and said second links to form therewith a three-link toggle connection, damper means contained within one of said links for restraining motion of said folding portion about its pivotal connection with said fixed portion, abutment means provided on said fixed portion, and means provided on said intermediate link for engagement with said abutment means, and actuator means carried by said intermediate link and adapted to cause rotation of said second and said intermediate links relative to one another.

6. The combination of claim 5 and wherein said damper means is contained within said first link.

7. In combination with a rotor blade having a fixed portion and a folding portion pivotally connected thereto, a blade folding mechanism comprising a first link pivotally connected to said folding portion, a second link pivotally connected to said fixed portion, and an intermediate link pivotally interconnecting said first and second links to form a three-link toggle combination operatively connected between said folding portion and said fixed portion, damper means contained within said first link for restraining motion of said folding portion about its pivotal connection with said fixed portion, and power means interacting between two of the links of said three-link toggle combination at their common pivotal connection for imparting motion to said links relative to each other, whereby said folding portion is pivotally moved relative to said fixed portion.

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