Aug. 27, 1963 R. D. LEONI 3,101,785

BLADE FOLDING DEVICE

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FIG. 1

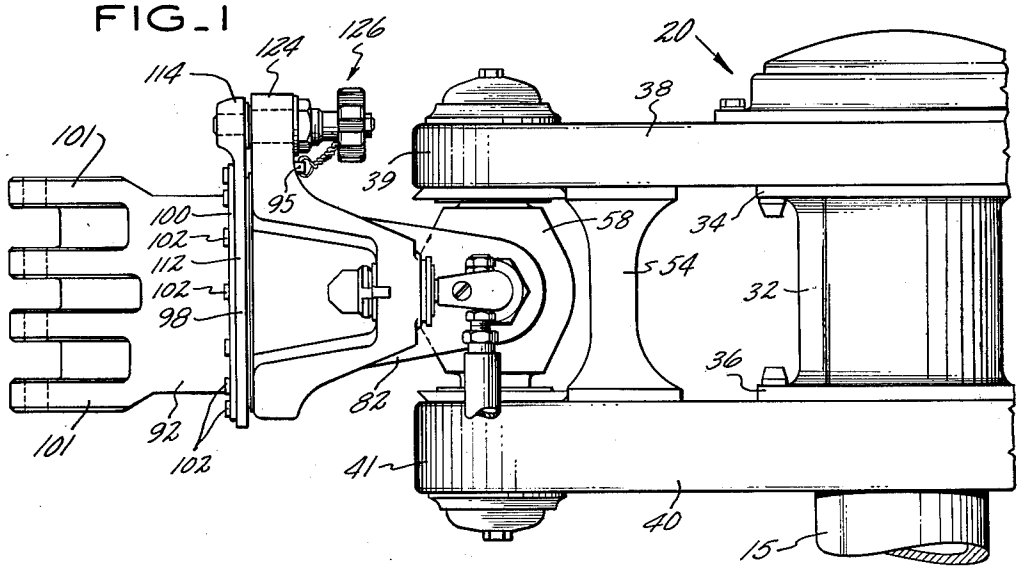

FIG. 2

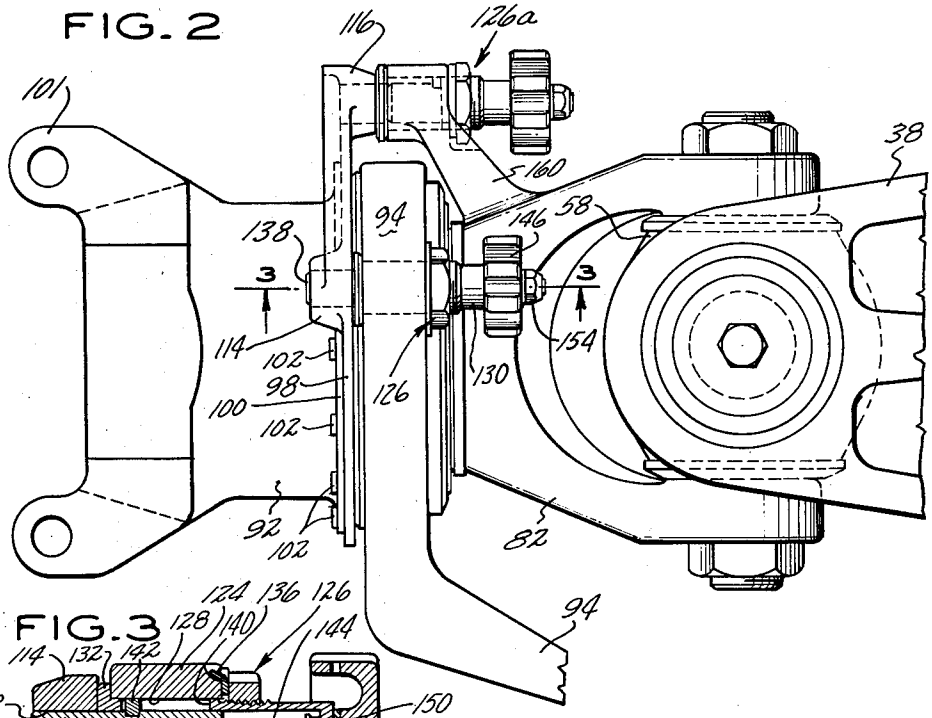

FIG. 3

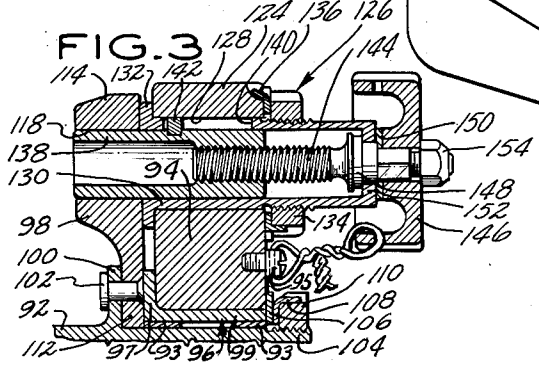

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FIG. 4

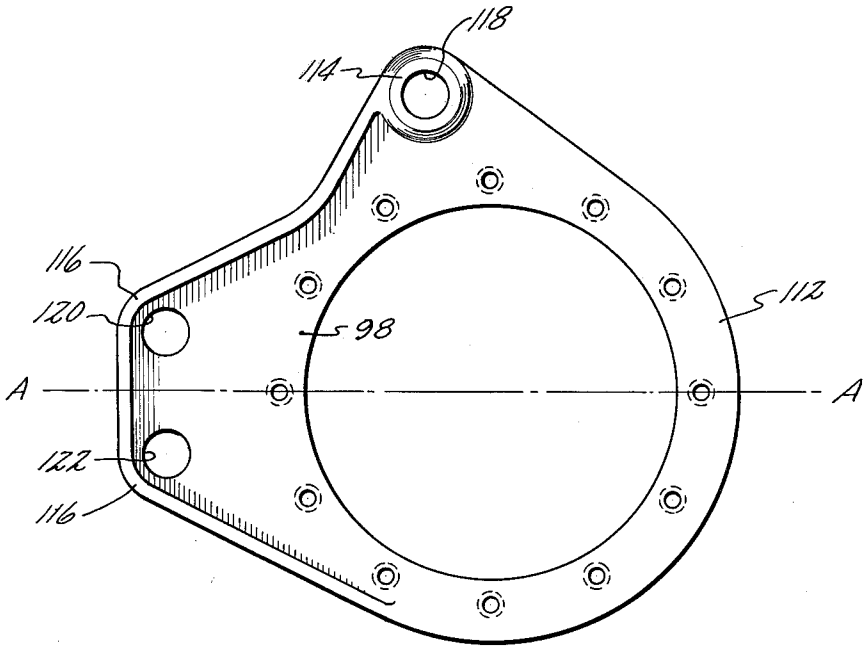
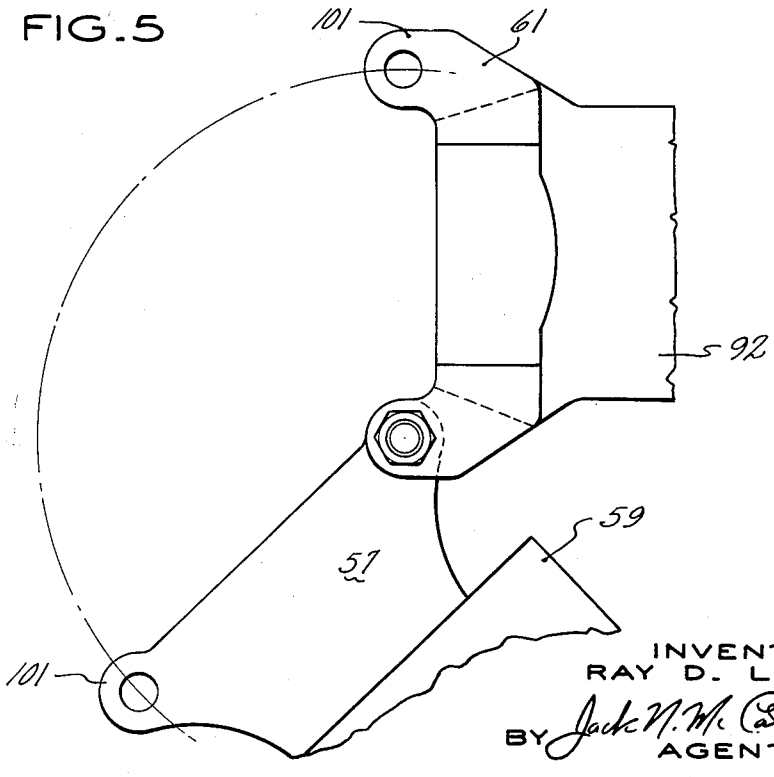


FIG. 5



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3,101,785

BLADE FOLDING DEVICE

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1 Claim. (Cl. 170—160.12)

This invention relates to a helicopter rotor head and more particularly to the blade attaching means.

An object of this invention is to provide means for folding a helicopter blade without the necessity of having an operator in the pilot's compartment to position the control means of the helicopter.

Another object of this invention is to provide means to permit folding blades which will unlock the connection between the blade pitch horn and its sleeve to remove the possibility of any unwanted stresses being passed therethrough.

A further object of this invention is to provide a connection between a blade sleeve and flapping link to position the blade sleeve during folding.

Another object of this invention is to provide means permitting a simple and positive manual folding procedure which will be quick and reliable.

Other objects and advantages of the invention will be evident in connection with the following detailed description of an embodiment of the invention shown in the accompanying drawings:

FIG. 1 is a side elevational view of a portion of a rotor head with an attached blade sleeve.

FIG. 2 is a slightly enlarged top view of a small portion of the rotor head along with the blade sleeve and connecting means therebetween.

FIG. 3 is an enlarged view taken along the line 3—3 of FIG. 2.

FIG. 4 is an end view of the holding plate.

FIG. 5 is a top view of the free end of the blade sleeve showing a blade pivoted about one side.

As herein shown, the rotor head 20 is of a known configuration having an upper plate 38 and a lower plate 40 fixed together in a spaced relationship by bolts which pass through spacers 54. The main drive shaft 15 carries a splined hub 32 having flanges 34 and 36 which are bolted to corresponding spaced plates 38 and 40. This connection permits the main drive shaft 15 to rotate the rotor head.

The plates 38 and 40 are formed having a plurality of projections 39 and 41, respectively, therearound which are located over each other and provide means in which a drag hinge 58 is journalled for each blade. A flapping link 82, having a forked end, is pivotally mounted on each drag hinge 58 and each link has a spindle extending outwardly therefrom on which a blade attaching sleeve 92 is mounted for rotation to provide for a pitch changing movement of a blade 59 with respect to the flapping link. Each blade 59 has a blade attaching member 57 fixed thereto forming at its free end one part of a blade folding hinge. The other part 61 is formed at the free end of the blade attaching sleeve 92. Parts 57 and 61 have two rows of hinge projections 101 which intermesh when the blade is in position on its respective blade attaching sleeve 92. Holes in the projections line up when the blade is in place so a blade holding pin is fixed in place through each row of intermeshing projections to affix the blade. It can be seen that when one wants to fold a blade, one blade holding pin can be removed and the blade can be rotated about the other pin. A blade pitch changing horn 94 is journalled on each sleeve 92 for relative movement therewith. As can be seen in FIG. 3, each blade pitch horn 94 has bearing means 96 located between the annular

portion of each blade horn 94 and the sleeve 92 about which it is positioned.

This bearing means includes an annular bearing member 99 and two small journal bearings 93 fixed to the sleeve 92. A sleeve holding plate 98 extends radially outwardly from each sleeve at a position on the sleeve which is outboard of the annular portion of the blade pitch horn 94. The holding plate 98 is fixed in position on the sleeve 92 to an integral flange 100 by rivets or bolts 102. Annular bearing member 99 includes a flange 97 which extends radially outwardly between the annular portion of the blade pitch horn 94 and sleeve holding plate 98. Each blade attaching sleeve 92 is externally threaded at its inner end at 104. This threaded portion extends from a point adjacent the inboard end of the blade attaching sleeve and the annular portion of its cooperating blade pitch horn 94. A washer 106 is placed over the end of each blade attaching sleeve along with a lock washer 108. An annular nut 110 is then placed on the thread portion 104 and tightened to a point which permits the blade pitch changing horn 94 to turn freely around the blade attaching sleeve 92 about the journal bearings 93. Each annular nut 110 is locked in its proper position by its cooperating lock nut 108.

Sleeve holding plate 98 is formed having an annular section 112 with two radial projections 114 and 116. A hole 118 extends through the outer end of projection 114 while two openings 120 and 122 extend through the outer extremity of projection 116. The openings 120 and 122 are circular and have their centers located the same distance from the center of the annular section 112. These openings are for a purpose to be hereinafter described.

The portion of the blade horn 94 surrounding each sleeve 92 has a projection 124 extending therefrom supporting a manually operated pin locking means 126. An opening 128 extends through the outer end of each projection 124. A sleeve 130 is fixed in the opening by an integral flange 132 on its outboard end and an annular nut 134 threadably mounted on the portion projecting inwardly from the projection 124 of the blade pitch changing horn 94. A lock washer 136 fixes this assembly in position. A member 138 is slidably mounted within the sleeve 130 for limited axial movement which is determined by the length of the slot 140 in the side of the sleeve 130. A pin 142 extending from the member 138 travels in the slot 140. Means for sliding said member 138 in the sleeve 130 comprises a bolt portion 144 which threadably engages threads which are formed internally of the member 138. Bolt 144 has a stem which extends through the inboard end of the sleeve 130 and has a handle 146 secured to the end projecting therefrom. The bolt is held against axial movement by a flange 148 formed on the stem and a washer 150 which are positioned on each side of an annular flange 152 at the inboard end of the sleeve 130. The handle 146 is fixed to the stem by placing a nut 154 on a thread portion of the stem extending from the handle. Means are provided for locking said handle 146 with reference to the blade pitch horn 94. Holes are provided in each handle 146 and a hole in provided on each horn 94 by the use of a nut 95 having a hole in its head. These can be used for lock wiring.

While FIG. 3 shows the member 138 projecting from the sleeve 130 into the hole 118 of the sleeve holding plate 98, it can be seen that rotation of the handle 146 can move member 138 to a position within the sleeve 130, so that the blade pitch changing horn 94 is no longer fixed for rotation with the sleeve 92.

Projection 116 of the sleeve holding plate extends to the side of its annular section 112 with each hole located the same number of degrees from a horizontal line A—A, hole 120 being above the line and hole 122 being

below the line. This particular plate is for a rotor head having three blades in which one is positioned for molding over the tail cone extending rearwardly while the other two blades will be projecting forwardly at an angle to the helicopter. The forward blade extending forwardly to the left will use hole **122** for folding while the blade extending forwardly to the right will use hole **120**. This angular positioning of the hinge point about which a blade is to fold provides for proper folding. It is to be understood that helicopters having different numbers of blades and different fuselage constructions will have these openings placed at different points around the periphery of the annular section **112**.

An arm **160** projects from each flapping link **82** having a blade to be folded in a direction opposite from that in which the blade pitch horn **94** projects. A manually operated pin locking means **126***a* is supported by the free end of the arm **160**. This locking means is identical to locking means **126** described above. The axis of the movable member slidably mounted within the pin locking means is located at a radius from the pitch changing axis of the blade attaching sleeve **92** which is equal to the radius at which the holes **120** and **122** are located. This construction permits the movable member of the pin locking means **126***a* to engage the cooperating hole of its respective blade. As set forth hereinbefore, the blade extending forwardly to the left will have the projecting member from its cooperating pin locking means **126***a* extending into hole **122** of the sleeve holding plate **98** and the blade extending forwardly to the right will have its member extending from its cooperating pin locking means **126***a* into hole **120**. It can be seen that this provides a positive connection between the blade attaching sleeve and the flapping link, which provides support of the blade against rotation about the pitch change means during the folding operation.

In operation as each blade is to be folded, the movable member or pin **138** of the cooperating pin locking means **126** is removed and the blade attaching sleeve **92** is rotated until the proper hole in the sleeve holding plate **98** lines up with the axis of the moveable member

or pin of the cooperating pin locking means **126***a*. The moveable member of this locking means is then placed in the proper lined up hole. The forwardly positioned blade holding pin is removed and the blade is rotated rearwardly to a folded position.

It is to be understood that the invention is not limited to the specific illustrations and description but may be used in other ways without departure from its spirit as defined by the following claim.

I claim:

In a helicopter, a rotor head, a blade, a blade attaching sleeve, means projecting from said rotor head, said blade attaching sleeve being mounted for rotation on said projecting means, said blade being connected to said sleeve, an annular member mounted on said blade attaching sleeve for rotation, an annular flange fixed to said blade attaching sleeve adjacent said annular member, said annular flange having a first and second radial projection extending outwardly therefrom, each radial projection having a hole located therethrough, first pin means fixed to said annular member, said first pin means having a first pin movable to engage the hole in said first radial projection of said annular flange of the blade attaching sleeve, means for controlling the rotation of said blade attaching sleeve, said control means including a first lever arm extending from said annular member, a second lever arm extending from said means projecting from said rotor head, said second lever arm having its free end adjacent said annular flange, and second pin means fixed to said second lever arm, said second pin means having a second pin movable to engage the hole in said second radial projection of said annular flange of the sleeve to position it against rotation with relation to said second lever arm at a predetermined angle for folding.

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