

June 20, 1939.

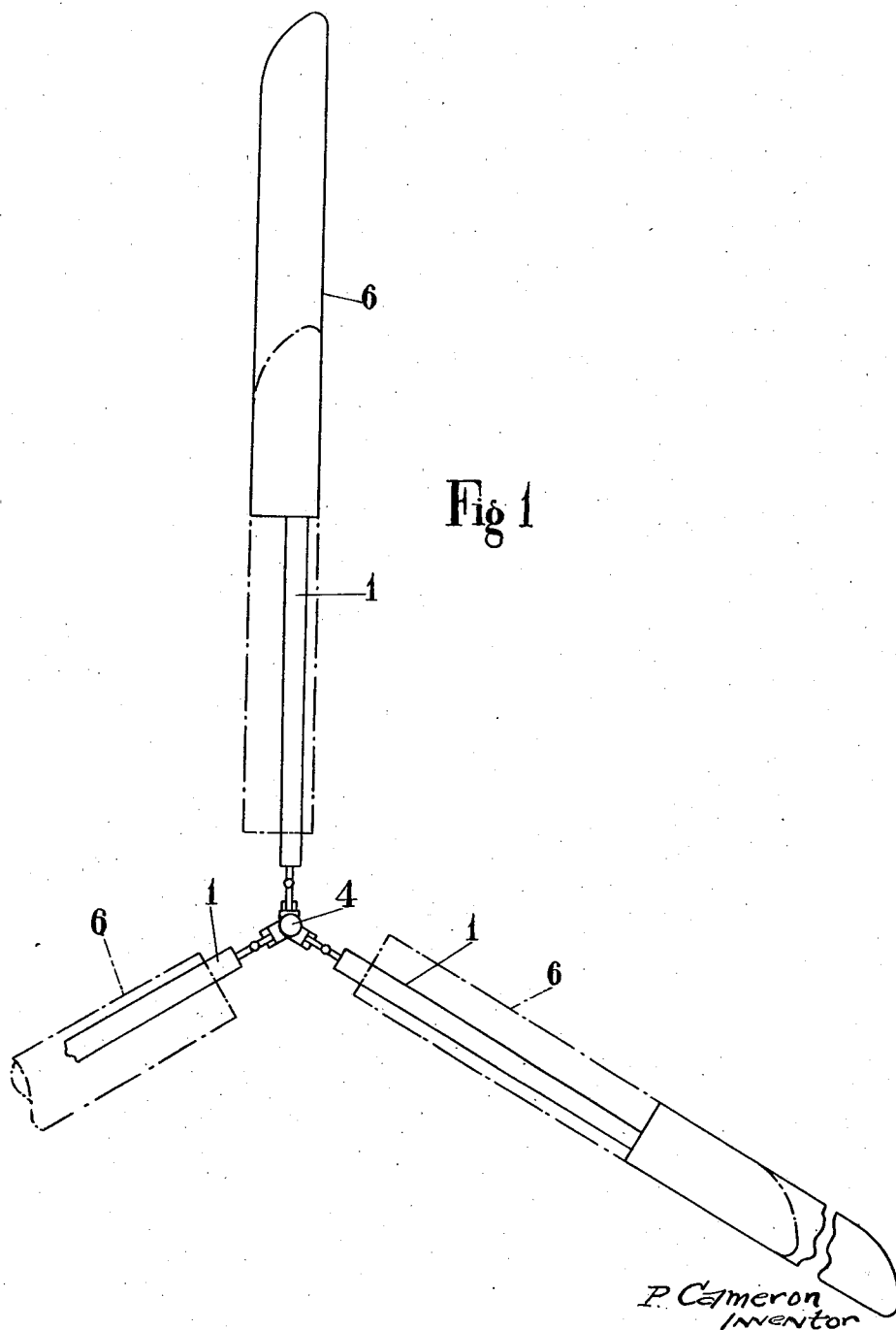
P. CAMERON

2,163,482

AIRCRAFT HAVING ROTATIVE SUSTAINING MEANS

Filed Dec. 24, 1936

3 Sheets-Sheet 1



By: *Glascow Downing & Seabell*
Attys

June 20, 1939.

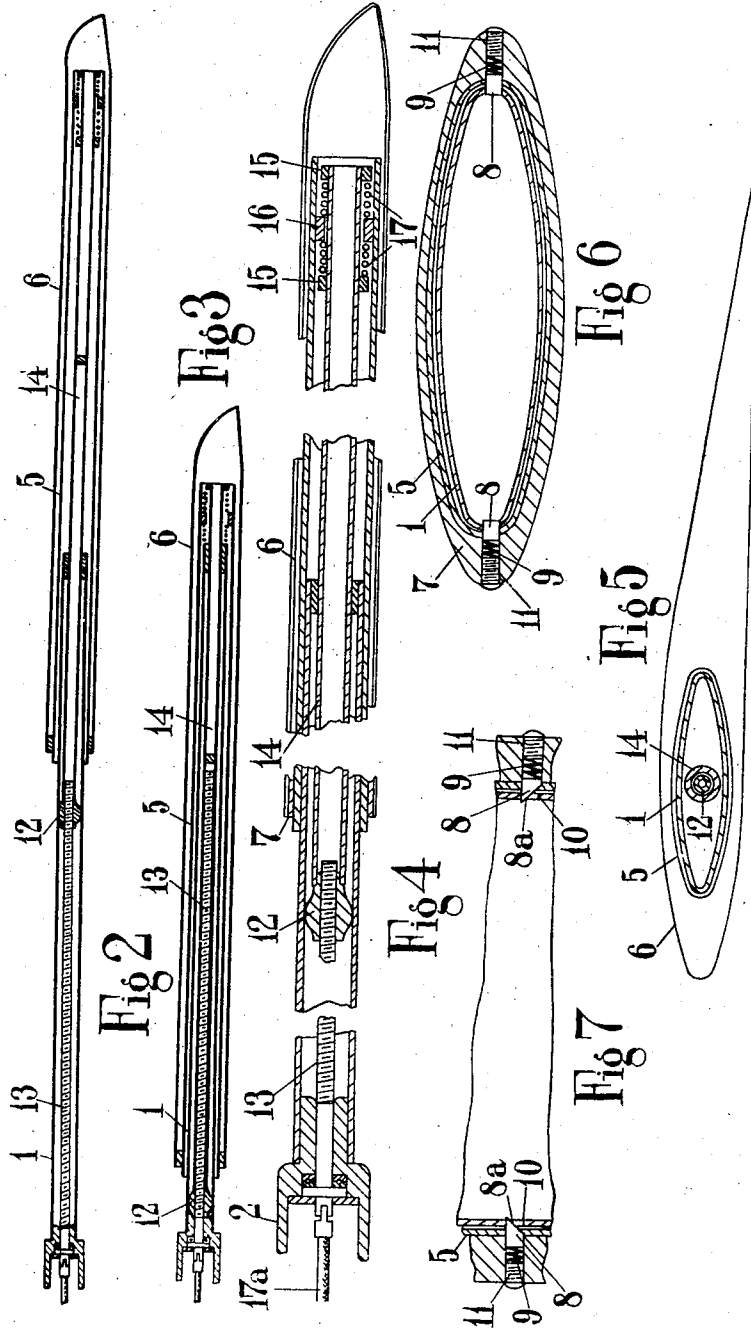
P. CAMERON

2,163,482

AIRCRAFT HAVING ROTATIVE SUSTAINING MEANS

Filed Dec. 24, 1936

3 Sheets-Sheet 2



P. Cameron
inventor
Atty:
By: Glascock Downing & Seabold

June 20, 1939.

P. CAMERON

2,163,482

AIRCRAFT HAVING ROTATIVE SUSTAINING MEANS

Filed Dec. 24, 1936

3 Sheets-Sheet 3

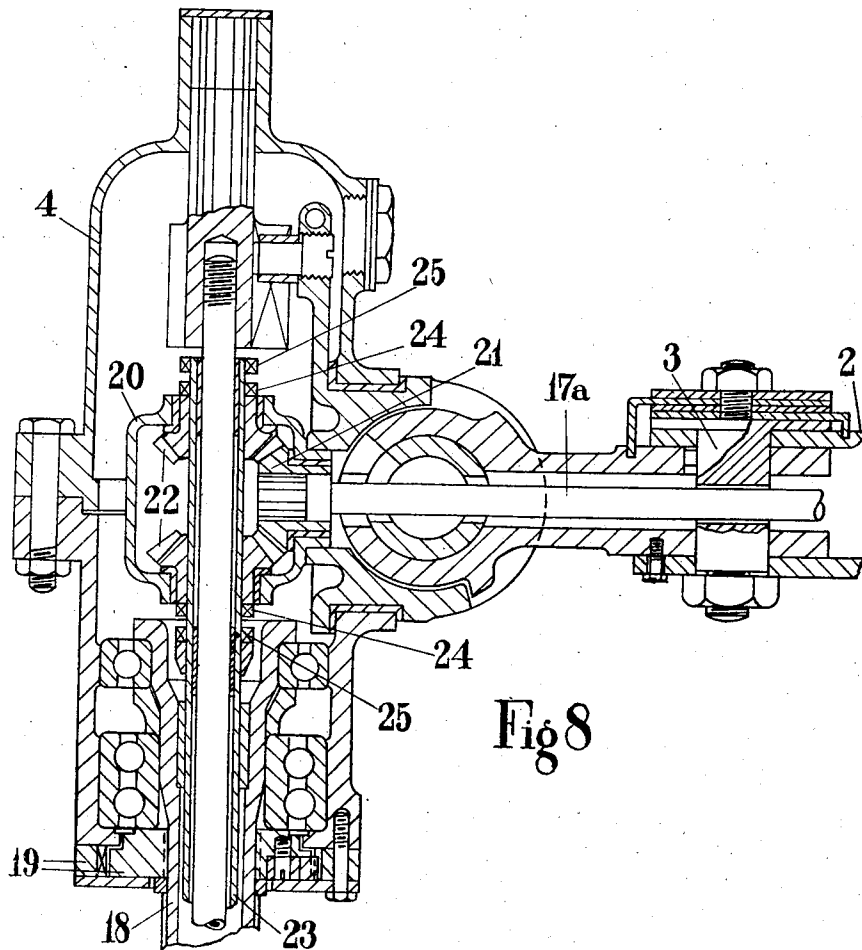


Fig 8

P. Cameron
Inventor

By: *Glascod Downing & Co.*
Attys.

UNITED STATES PATENT OFFICE

2,163,482

AIRCRAFT HAVING ROTATIVE SUSTAINING MEANS

Peter Cameron, Kelvinside, Glasgow, Scotland

Application December 24, 1936, Serial No. 117,627
In Great Britain January 1, 1936

12 Claims. (Cl. 244-17)

This invention relates to aircraft having sustaining means consisting of rotor blades which can be extended and retracted.

During rotation the blades become flexed upwardly, the degree of flexure of each blade varying with the resistance encountered thereby.

For example, when the aircraft is stationary and the blades are rotating, all the blades are flexed upwardly to the same extent, assuming that there is no wind which would result in the blades encountering a varying resistance sufficient to flex the blades.

When the aircraft is travelling forwards the flexure of each blade in turn varies in accordance with the position of the blade or air resistance encountered. When the blades are advancing they encounter substantial resistance and in consequence are substantially flexed, and when the blades are retreating and also when they are commencing to advance the flexure is relatively small.

When the blades are stationary, and also when they are not flexed, there are no mechanical difficulties in extending and retracting them, but when the blades are rotating and their degree of flexure varies during each rotation the resistance offered by the flexed blades to extension and retraction is so great that it would be quite impossible for the pilot to extend and retract the blades under such conditions.

The present invention has for its primary object to provide means whereby the pilot can extend and retract the blades irrespective of the degree of flexure attained by the blades during their rotation.

Further objects of the invention will become apparent from the specification and are set forth in detail in the claims at the end thereof.

One form of the invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is a plan of the rotor head having three blades.

Figure 2 is a vertical section along the centre line of one blade in the extended position.

Figure 3 is the same as Figure 2 in the retracted position.

Figure 4 is a portion of a longitudinal section of a blade on a larger scale.

Figure 5 is a cross section of the blade.

Figure 6 is a cross section of the collar on the tube.

Figure 7 is a horizontal section of Figure 6.

Figure 8 is a sectional elevation of the rotor head.

In the embodiment of the invention illustrated

the telescopic support comprises a hollow member 1, preferably of oval or aerofoil cross section, provided with a fork 2 at one end which is adapted to be secured by means of a pin 3 or the like, see Figure 8, to the rotor head 4 of an aircraft. This hollow or inner member is provided with another hollow member 5 of similar cross section, which is adapted to slide thereon and on this hollow member the usual supports or ribs, not shown, are mounted, on which the covering 6 of the blade is secured.

A collar or the like 7 is provided at the inner end of said outer hollow member, and this collar is provided with, in preference, two stops or the like 8 which are pressed towards the inner member by means of springs 9. These stops are adapted to engage in holes or slots 10 in the inner member when the blade is extended to the maximum radius, the stops then dropping into the slots in the inner tube. The outer face of the stop is at right angles to the surface of the tube, thus holding the blade from extending any further, but the inner edge of the stops is provided with a sloping surface 8^a so as to offer no resistance to the blade when being retracted into its unextended position. The compression in the springs can be regulated by the screws 11.

Mounted within the inner tube is a nut or the like 12 capable of sliding therein, in which an internal thread is provided which engages with a screwed rod 13 mounted in a suitable thrust bearing in the fork so as to prevent it from longitudinal movement. To this nut is secured a tube 14, which totally encloses the portion of the screwed rod which projects outwards, and on the end of this tube are provided two collars or the like 15, between which a thrust member or collar 16 rigidly fixed to the outer member 5 is located. Suitable resilient means such, for instance, as helical compression springs 17, encircle the tube 14 between the two collars and the thrust member, such that the blade can move to a certain extent longitudinally on the inner member without rotation of the screwed rod taking place, and the screwed rod can move longitudinally to a limited extent independently of the blade. Any other resilient means, such as oil buffers or the like, may be employed.

The inner end of the screwed rod, when it projects into the fork, is provided with a slot which is adapted to engage with a projection in a member mounted upon the end of a flexible member 17^a to which rotational movement can be imparted. By such means on rotation of the screw in one direction the blade will be extended and

then on rotation in the opposite direction the blade will be retracted to its unextended position. The blade may be retained in any intermediate position.

5 In Figure 1 the full lines show the blades in the extended position and the chain dotted lines show them in the retracted position.

In order to provide additional safety means so that the blade cannot be extended beyond the maximum radius or cannot fly off should the screw or other means become detached, further stops 8 may be provided at different distances along the blade so that the stops drop into slots arranged in different positions. The slots may all be arranged so that all the stops act at the same maximum distance or so that the different sets of stops act one after the other, the additional sets being kept as a stand-by or reserve, and only used when one or more sets fail to come into operation. Further, inspection holes, not shown, may be provided in the blade so that the stops may be inspected to see that they are in working order and then suitable covers or the like may be provided to cover up the inspection holes so as to leave a smooth surface.

When the blades of the aircraft are rotating and the machine is stationary, all the blades are flexed upwardly to the same amount, but directly the machine begins to travel horizontally the flexure of the blade varies in accordance with the position of the blade and when the blade is retracting, the flexure is at its minimum. When it is required to extend or retract the blades if the screw is rotated and the blade is very much flexed, the flexure will prevent the blade from being moved, or permit only a small movement thereof but immediately the blade attains the position where the flexure is reduced the resilient means, which has the energy stored therein, will move the blade out or in, and then during the rest of the revolution the energy is again stored so that when the flexure is reduced the blade will again be operated in the desired direction. Centrifugal force will act alone or in conjunction with the resilient means to move the blades outwards. In this manner through the resilient means the blades will be capable of being extended or retracted whatever the speed or the pressure.

It is found also that the resilient means take up longitudinal shocks and are found very effective in reducing vibration in this direction.

Further, since there is only one position in which the blade has the minimum flexure, means may be provided whereby the screws may be rotated only in this position so that the drive of the screw will then only operate to extend or retract the blade in its position of minimum flexure, and by this means the resilient means may also be eliminated.

60 The tube 14 which covers the screw member within the blade may be filled with oil so, as to form an oil bath to make the screw operable with the least amount of friction, and any suitable means may be provided for refilling the tube with oil.

65 The inner tube is left exposed without any blade thereon for a suitable distance near the rotor head, either by the blade not being retracted to the minimum radius or by arranging that the inner tube does not slide right into the outer tube. By this means the blade portion is clear of the rotor head. This enables the two or more blades to be folded back so that all lie parallel to one another and point directly to the tail of the machine, and therefore reduce the width and over-

all length of the machine, thus making it much more convenient for handling or garage purposes.

The extension may be of any desired amount according to the size of the blade and the purpose for which it is to be used. Further, the inner and outer sliding members may be of any other form in cross section than that described as long as means are provided when of circular cross section to prevent them from rotating relatively to one another.

The rotor head, illustrated in Figure 8, is similar to that illustrated and described in my co-pending patent application of even date, and only such parts thereof will now be described as are necessary to show how, according to one arrangement, the screw threaded rods 13 can be rotated to extend and retract the blades.

The rotor head 4 is mounted on a hollow shaft 18 by which the head is driven through a one-way drive 19 from any convenient source, or the head may rotate under the action of the rotating blades.

Located within a gear casing 20 mounted within the rotor head, are three bevel wheels 21, only one of which is shown, the axes of the three pinions being at right angles to that of the driving shaft. Each pinion is connected to a flexible connection 17^a, which in turn makes a driving connection with one of the screw threaded rods 13, as above set forth.

Meshing with the bevel wheels 21 are two crown wheels 22 through which passes freely a hollow spindle 23. The crown wheels carry dog clutch members 24, while said spindle carries the complementary clutch members 25. Any suitable means are provided to move said spindle longitudinally so that one or the other of said crown wheels is clutched thereto and further means provided to lock said spindle against rotation, suitable means for effecting both operations being set forth in my said co-pending application.

When the rotor head 4 is rotating and the hollow spindle 23 moved axially so that the top or bottom crown wheel is locked thereto by a dog clutch, and when said spindle is prevented from rotating, it follows that the bevel wheels 21, which are carried round by the rotor head, must be rotated about their own axes. The bevel wheels then transmit their motion through the flexible connections 17 to the screw threaded rods 13 and thus extend or retract the blades.

When the blades are in the desired position the spindle is moved axially so that both crown wheels are free, the drive to screw threaded rods being thereby stopped.

It will be understood that, from the above description, the invention covers different methods and mechanisms for extending and retracting said blades without departing from the scope of the invention.

What I claim is:

1. For flying machines of the type set forth a rotor head, hollow radially extending members secured to said head, outer hollow members telescopic on said radially extending members, rotor blades secured to said outer members, a screw threaded spindle extending through each inner hollow member, a nut threaded on said spindle, a hollow rod carried by said nut and resilient means connecting said hollow rod and said outer hollow member together.

2. In a flying machine of the type set forth the combination including a rotor head, hollow radially extending members secured to said head, outer hollow members telescopic on said radially

extending members, rotor blades secured to said outer members, a screw threaded spindle extending through each inner hollow member, a nut threaded on said spindle, a hollow rod carried by said nut, resilient means connecting said hollow rod and said outer hollow member together, articulated members connecting said blades to said rotor head, and means in said rotor head for rotating said screw threaded spindles.

3. For aircraft of the type set forth a rotor head, telescopic blade supports carried by said head, rotor blades carried by said supports and means for moving said blades radially, said means including a device by virtue of which, when the aircraft is in flight and each blade flexed to various degrees during its rotation, said means operates on each blade in turn to move it radially, only when its flexure is relatively small.

4. For aircraft of the type set forth, a rotor head, telescopic blade supports carried by said head, rotor blades carried by said supports and means for moving the said blades radially, said means including means for causing said first mentioned means to cease to function on each blade in turn when the resistance due to flexure becomes too great and to function on each blade in turn during part of its rotation when its flexure is less.

5. For aircraft of the type set forth a rotor head, telescopic blade supports carried by said head, blades carried by said supports and means for moving said blades radially, step by step, said means including means by which when the aircraft is in flight each blade in turn can be moved radially step by step and only when the flexure of the blade caused by the air resistance is relatively small.

6. For aircraft of the type set forth a rotor head, telescopic blade supports carried by said head, rotor blades carried by said supports, operating means by which the blades can be moved radially and resilient means incorporated between the head and each blade, which resilient means, when the flexure of a blade is such that too great resistance is offered to its radial movement by reason of its flexure, takes up the movement of the blade operating means and transmits same to the blade when its flexure is less.

7. For aircraft of the type set forth a rotor head, telescopic supports carried by said head, rotor blades carried by said supports, screw means for extending and retracting the blades and resilient means incorporated between the blades and screw means, which resilient means permit the screws to rotate irrespective of the degree of flexure of any of the blades, and where the flexure is such that the blades offer too great resistance to the resilient means, the resilient means take up the movement and transmit same to the blades when their degree of flexure is less.

8. A rotor head for aircraft of the type set forth having hollow radially extending members secured to said head, outer hollow members telescopic with respect to said radially extending members, rotor blades secured to said outer members, a screw-threaded spindle extending through each radially extending hollow member, a nut threaded on said spindle, a hollow rod carried by said nut, resilient means incorporated between said hollow rod and said outer hollow member, and means for rotating in unison the screw-threaded spindle of each blade, the construction being such that where the blades are flexed the movement of the screws is taken up by the resilient means which, when the blades are at a lesser flexure, then operate to extend or retract its blade.

9. A rotor head and blades for aircraft of the type set forth comprising the combination including a rotor head, hollow radially extending members secured to said head, outer hollow members telescopic with respect to said radially extending members, rotor blades secured to said outer members, a screw-threaded spindle extending through each radially extending hollow member, a nut threaded on said spindle, a hollow rod carried by said nut, resilient means interposed between said hollow rod and said outer hollow member, articulated members connecting said blades to said rotor head, and means in said rotor head for rotating said screw-threaded spindles simultaneously.

10. In a flying machine of the type set forth the combination including a rotor head, hollow radially extending members secured to said head, outer hollow members telescopic on said radially extending members, rotor blades secured to said outer members, a screw threaded spindle extending through each inner hollow member, a nut threaded on said spindle, a hollow rod carried by said nut, resilient means connecting said hollow rod and said outer hollow member together, articulated members connecting said blades to said rotor head, rotatable means in said rotor head for rotating said screw threaded spindles and flexible means connecting the rotatable means to the said spindle.

11. For aircraft of the type set forth, a rotor head, telescopic blade supports carried by said head, rotor blades carried by said supports, and means for moving said blades radially, said means including means whereby when in flight each blade can be moved radially and individually and solely during a part of the rotation of the blade.

12. The device as claimed in claim 4 in which there are means independent of the means for moving the blade radially which positively lock the blades against further outward movement when they are at their maximum radius.

PETER CAMERON.