March 27, 1934. M. MANSSON 1,952,812

PROPELLER

Filed May 29, 1931 2 Sheets-Sheet 1

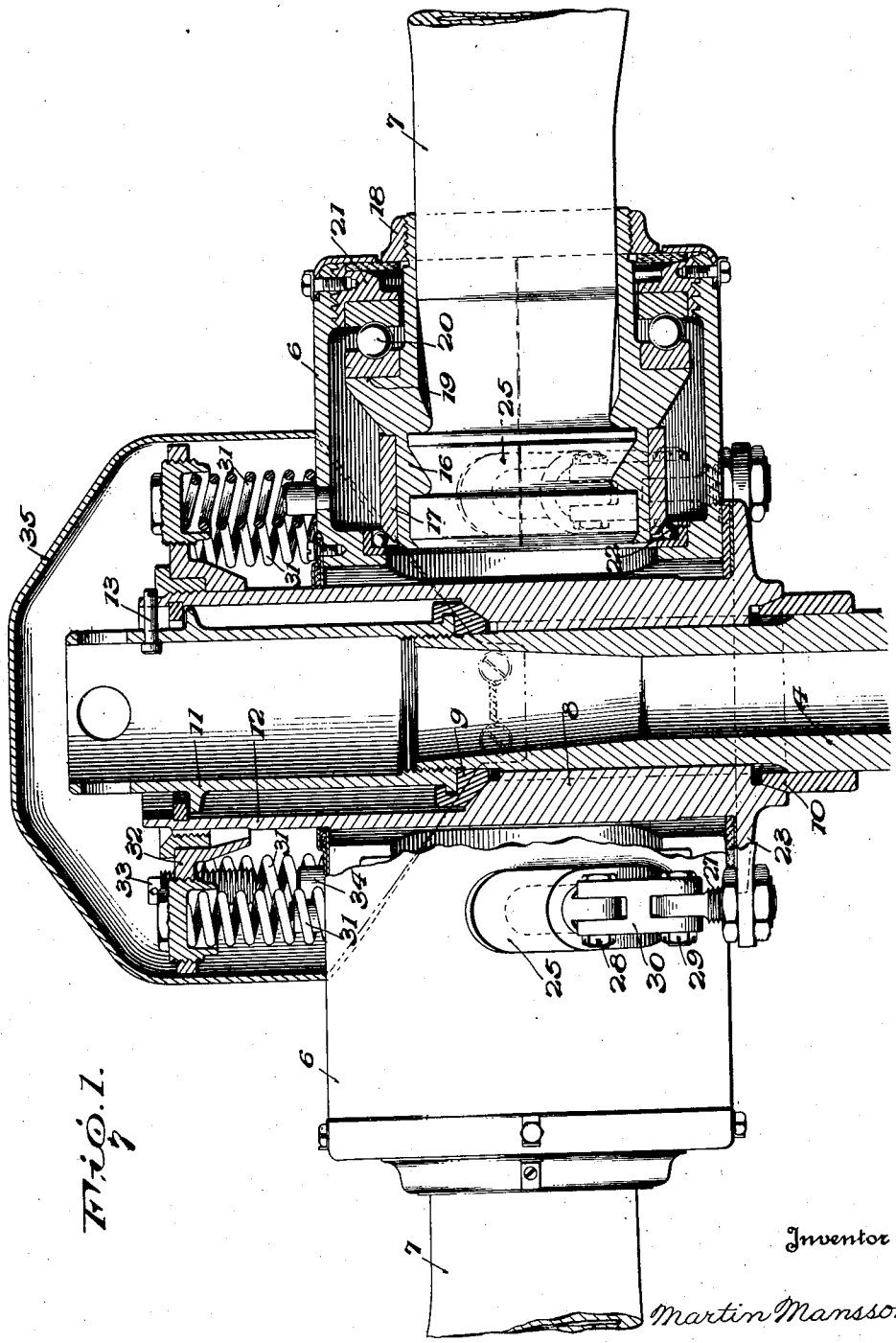


Fig. 1.

Inventor

Martin Mansson

By

F. B. Smith

Attorney

March 27, 1934. M. MANSSON 1,952,812

PROPELLER

Filed May 29, 1931 2 Sheets-Sheet 2

Fig. 2.

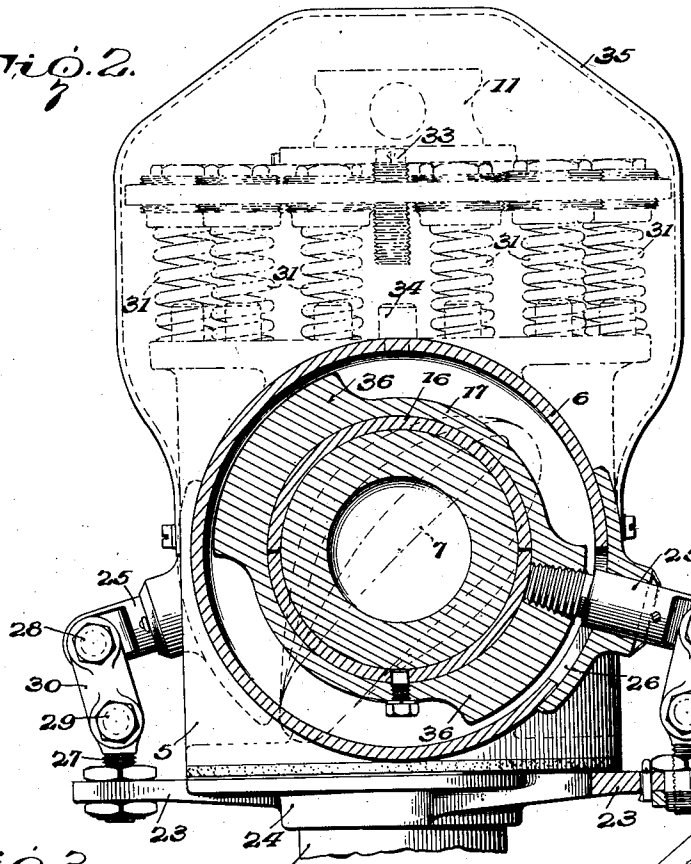
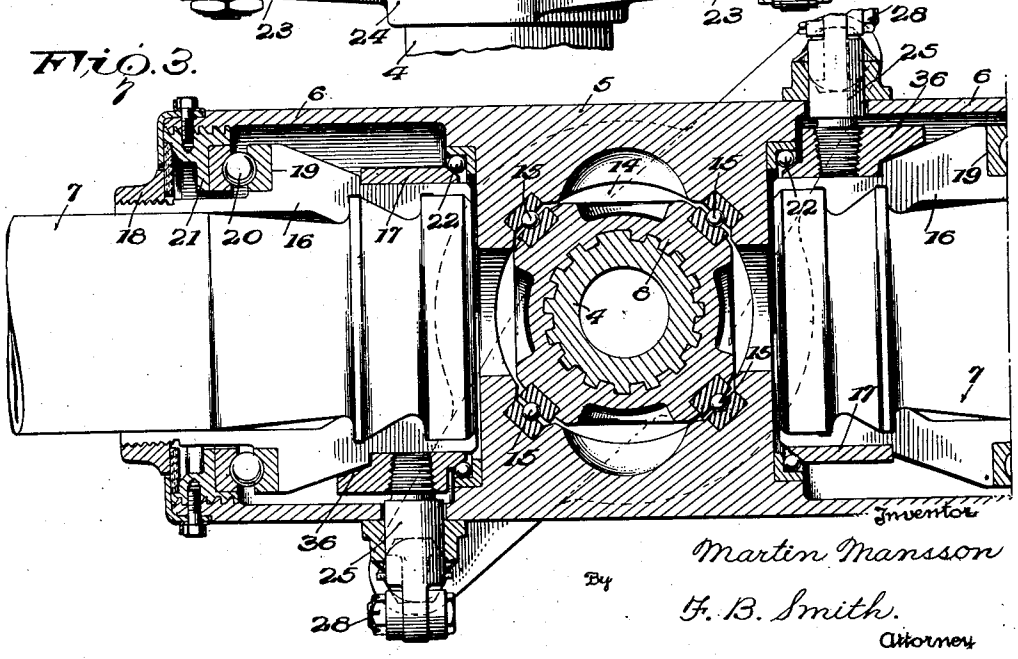


Fig. 3.



Inventor

Martin Mansson

By F. B. Smith.

Attorney

Patented Mar. 27, 1934 1,952,812

UNITED STATES PATENT OFFICE

1,952,812

PROPELLER

Martin Mansson, East Orange, N. J., assignor to Bendix Research Corporation, East Orange, N. J., a corporation of Indiana

Application May 29, 1931, Serial No. 541,014

16 Claims. (Cl. 170—162)

This invention relates to propellers and more particularly to propellers of the type having a plurality of blades, the angularity or pitch of which may be varied during operation.

One of the objects of the present invention is to provide a variable pitch propeller embodying novel means for varying the pitch of the blades thereof during operation.

Another object of the invention is to provide in a propeller of the type having a hub relatively movable with respect to the propeller shaft, novel means embodying a mechanism secured to the propeller shaft rearwardly of the hub, for varying the pitch of the propeller blades during such movement of the hub.

Still another object is to provide in a variable pitch propeller of the above character, wherein relative movement of the hub with respect to the shaft is secured automatically in response to the thrust of the blades, mechanism for varying the pitch of the blades during such movement, which mechanism is disposed rearwardly of the propeller hub and externally thereof, whereby the aerodynamical efficiency of the propeller will be increased and a saving in weight may be effected, which features are especially desirable in aircraft installations.

A further object is to provide in a variable pitch propeller a novel and compact arrangement of parts which shall not only be light in weight but also embody a construction wherein the parts may be readily accessible for inspection and wherein also an exceedingly reliable and efficient structure is realized.

Other objects and novel features of the invention, not specifically referred to above, will appear more fully hereinafter from the following detailed description, when taken in connection with the accompanying drawings, wherein there is illustrated one embodiment of the invention. It is to be expressly understood, however, that the drawings are for purposes of illustration only and are not designed as a definition of the limits of the invention, reference being had for this purpose to the appended claims.

In the drawings, wherein similar reference characters refer to similar parts throughout the several views:—

Fig. 1 is a plan view partly in section of a propeller embodying the present invention;

Fig. 2 is a side view partly in section of the parts illustrated in Fig. 1; and

Fig. 3 is a transverse section of the propeller.

Referring more particularly to Figs. 1 and 3, a propeller constructed in accordance with the principles of the present invention is illustrated therein as including a rotatable engine shaft or extension thereof 4, and a hub 5 drivably connected thereto but relatively movable longitudinally thereof in response to the thrust exerted by the blades, the hub being provided with a plurality of radially extending sockets 6 adapted to rotatably receive the inner or root ends of propeller blades 7, there preferably being also provided suitable means for rotating the blades 7 in their respective sockets to vary the pitch of said blades during the aforesaid thrust-responsive movement of the hub relative to the shaft, as will appear more specifically hereinafter.

In order to drivably connect the hub 5 to the shaft 4, a driving member or block 8 is splined to the shaft, Figs. 1 and 3, and is maintained rigidly thereon as by means of split front and rear cones 9 and 10 respectively, a nut 11 threadedly received by the outer end of shaft 4 and interlocked with the front cone 9 being provided for maintaining these parts in proper position. After assembly the nut 11 is preferably locked to an outwardly extending portion 12 of the driving block 8 as by means of a pin 13. The hub 5 is provided with a centrally positioned aperture or opening 14, Fig. 3, which is adapted to receive the driving block 8, and a plurality of rows of ball bearings 15 are interposed between the driving block and hub in order to permit substantially frictionless relative longitudinal movement between these two members.

Means are provided for rotatably mounting the inner or root ends of the blades 7 within the sockets 9, and preferably such means are constituted in such a manner as to enable the utilization of the type of propeller blade now used in practice. As shown, such means include a longitudinally split sleeve 16, the two parts of the sleeve being firmly secured around the root ends of the blades by means of an inner ring 17 and an outer ring 18 threadedly received by the sleeve. The exterior surface of the sleeve is preferably so formed as to provide an annular shoulder 19 adapted to form an inner seat for an annular row of ball thrust bearings 20, the outer seat for said bearings being carried by a thrust ring 21, threaded into the outer ends of each of the sockets 6 and serving to maintain the propeller blades 7 securely within said sockets. Preferably there is also provided a plurality of ball bearings 22 positioned within each socket at the inner end thereof between the hub 5 and the ring 17, in order to decrease the

resistance to rotation of each blade in its respective socket.

Means are provided for interconnecting the shaft and each respective blade in such a manner as to rotate the blades in their sockets to vary the pitch thereof during longitudinal movement of the hub with respect to the shaft, and preferably such means are secured to the shaft rearwardly of the propeller hub. In the form of the invention illustrated, such means are constituted by a lever or link mechanism, Fig. 2, one end of which is operatively connected with the ring 17, rigidly secured to the root end of the blade 10, while the other end is secured to a lateral extension or arm 23 formed integrally with a plate 24 carried by the shaft 4. More particularly, the above link mechanism comprises a stud 25 secured to the ring 17 and extending laterally of the propeller blade and through a suitable aperture 26 formed in the hub socket 6, and a bolt 27 suitably secured to the arm 23, the bolt and arm being pivotally connected as by means of bolts 28 and 29 to the bifurcated end portions of a link 30. From this construction, it will readily be observed that since one end of the link mechanism is rigidly secured to the shaft 4, the said mechanism will effect rotation of each blade about its longitudinal axis in order to vary the pitch during longitudinal thrust-responsive movement of the hub relative to the shaft.

In order to yieldingly oppose forward axial movement of the hub with respect to the shaft for the purpose of arresting such movement at certain positions along the shaft in accordance with the degree of thrust exerted by the blades under the existing conditions, there is preferably provided a plurality of resilient members such as, for example, coil springs 31, arranged concentrically with respect to the shaft and interposed between the hub 5 and a plate 32 secured in any suitable manner to the portion 12 of the driving block 8. If desired, a plurality of adjustable stops 33 carried by the plate 32 and adapted to cooperate with aligned studs 34 carried by the hub sockets 6 may be provided for positively limiting the forward movement of the hub, the said stops and studs thus serving to predetermine the lower pitch limit which the blades assume in operation, it being pointed out that when the parts are in the position shown in Fig. 1, the pitch of the blades is a maximum, the pitch being gradually reduced during forward movement of the hub relative to the shaft, until the studs 34 contact with the stops 33. A housing or nosepiece 35 of suitable shape and preferably carried by the hub, encloses the springs 31 and serves to increase the aerodynamical efficiency of these parts as well as to form a protective covering against rain, snow, etc.

In order to substantially neutralize or compensate the propeller from the effects of torsion on the blades, the net effect of which is to constantly tend to decrease the pitch of the blades while the propeller is operating or in other words, as viewed in Fig. 2, tends to turn or twist the blade 7 in a clockwise direction to effect a forward movement of the hub, the rings 17 associated with the root ends of each blade are counterweighted or enlarged at diametrically opposed sides as indicated at 36. The effect of these counterweights, as will be more particularly pointed out hereinafter, is to substantially oppose or offset the net torsion on each respective blade while the propeller is rotating.

During operation, considering the shaft 4 to be rotating in a clockwise direction as viewed in the drawings, the hub 5 and blades 7 rotatably carried thereby will be moved axially of the shaft and relative thereto in response to the degree of thrust exerted by the blades, the link mechanisms referred to above being effective to rotate the blades about their longitudinal axes to vary the pitch. The springs 31 interposed between the plate 32 rigidly carried by the shaft, and the hub, will be effective during the above described thrust-responsive movement of the hub to yieldingly resist such movement and arrest the forward travel of the hub in such a position as to yield maximum propeller efficiency for the thrust exerted by the blades under the given conditions.

Referring more particularly to Fig. 2, as heretofore pointed out, during operation torsion on the blades will tend to reduce the pitch thereof, and as viewed in this figure will tend to rotate the blade 7 in a clockwise direction, thus placing links 30 in compression and moving the hub forwardly of the shaft 4, whereupon the pitch of the blades will be decreased. However, the effect of centrifugal force on the weighted portions 36 of the rings 17 secured to the root of each blade will tend to turn the latter in a counterclockwise direction, thus partially counteracting the above referred to torsion. It is to be pointed out, however, that in certain instances it may be desirable not to wholly counteract the torsion on the blades, in which event the links 30 would always be in compression during operation.

There is thus provided by the present invention a novel variable pitch propeller of the type wherein automatic relative axial movement thereof with respect to the propeller shaft is employed for varying the pitch of the blades and embodying novel connections for securing such varation in pitch. The provision of the link mechanism interconnecting the blades and shaft and connected to the latter rearwardly of the blades serves not only to increase the aerodynamical efficiency of the entire propeller, but also results in a saving in weight. In instances wherein the torsion on the blades is not entirely neutralized and the link mechanisms are thus placed in compression, it will readily be observed that an added degree of safety is provided since even though a fracture or breakage occurs in such link, the compression existent therein will be effective to maintain the parts in firm engagement.

While there has been shown and described only one embodiment of the invention, it is to be understood that the same is not limited thereto but may be embodied in various mechanical forms. It is also to be understood that various changes may be made in the relative sizes, shapes and relative locations of the parts without departing from the invention, as well understood by those skilled in the art. Reference will therefore be had to the appended claims for a definition of the limits of the invention.

What is claimed is:

1. A propeller having a hub, a plurality of blades carried thereby, a driving shaft, means for drivably connecting said hub and shaft, means responsive to the thrust of said blades for moving the hub axially of said shaft, and means including a link mechanism operable during such movement to change the pitch of said blades, a portion of said mechanism being positioned rearwardly of said hub.

2. A propeller comprising a plurality of blades, a rotatable shaft, a hub, means for drivably connecting said hub and shaft, said hub being mov-

able with respect to said shaft in response to the thrust of said blades, and means including link mechansms interconnected between said shaft and blades and having an element positioned rearwardly of the hub for rotating the blades about their longitudinal axes to vary their pitch during thrust-responsive movement of the hub.

3. In a propeller having a plurality of blades, means responsive to the thrust of said blades for decreasing the pitch thereof, said means including a mechanism disposed rearwardly of the propeller, and means for substantially neutralizing the torsion of the blades.

4. A propeller comprising a plurality of blades, means for rotating said blades, means operable automatically in response to the thrust of the blades to decrease the pitch of the blades, said means including pivoted members interconnected between said rotating means and said blades, said members being connected with said rotating means rearwardly of the blades, and means responsive to centrifugal force for substantially neutralizing the torsion of the blades.

5. A propeller comprising a hub, a plurality of blades rotatably carried by said hub, a rotatable shaft, means for drivably connecting said hub and shaft, said hub being longitudinally movable with respect to said shaft, and means operable during such movement to vary the pitch of the blades, said means including a plate rigidly secured to the shaft rearwardly of the hub, a pair of lateral extensions on said plate, and mechanism interconnecting the lateral extensions and said blades.

6. A propeller comprising a hub, a plurality of blades rotatably carried by said hub, a rotatable shaft, means for drivably connecting said hub and shaft, said hub being longitudinally movable with respect to said shaft, and means operable during such movement to vary the pitch of the blades, said means including a member rigidly secured to said shaft and positioned rearwardly of the hub, said member being provided with a plurality of outwardly extending arms, and means for pivotally connecting the outer end portions of said arms and said blades.

7. A propeller hub comprising a driving member, a hub member drivably connected thereto, said hub member being movable longitudinally with respect to said driving member, a shaft drivably connected to said driving member, a plurality of propeller blades rotatably mounted in said hub, and means for rotating said blades in the hub during longitudinal movement of the latter relative to the driving member to vary the pitch of said blades, said means including a plate secured to the shaft and positioned exteriorly and rearwardly of the hub, a stud secured to each blade, and link mechanisms interconnecting said studs and said plate.

8. In a propeller having a plurality of blades and a hub, means responsive to the thrust of said blades for decreasing the pitch thereof, said means including a mechanism positioned externally and rearwardly of the hub.

9. In a propeller having a hub, a plurality of blades carried thereby, a rotatable shaft drivably connected with the hub, said hub being automatically movable axially of the shaft for varying the pitch of the blades, and means interconnecting said shaft and blades for varying the pitch of the latter during such axial movement of the hub, said means including a member secured to the shaft rearwardly of the hub and extending laterally of the shaft.

10. In a propeller having a hub, a plurality of blades carried thereby, a rotatable shaft drivably connected with the hub, said hub being automatically movable axially of the shaft for varying the pitch of the blades, and means interconnecting said shaft and blades for varying the pitch of the latter during such axial movement of the hub, said means comprising a member secured to each blade and projecting through said hub, a member secured to the shaft and extending laterally on either side thereof, said last named member being positioned rearwardly of the hub, and links pivotally connecting said first and second named members.

11. A propeller of the class described comprising a rotatable shaft, a hub drivably connected with said shaft, a plurality of blades rotatably mounted in said hub, the latter being longitudinally movable with respect to the shaft in response to the thrust exerted by said blades, means operable during thrust-responsive movement of the hub with respect to the shaft for varying the pitch of the blades, said last-named means including connections between the blades and the shaft, said connections being secured to the shaft rearwardly of the propeller, and means for partially compensating for the torsion of the blades.

12. In an aeronautical propeller comprising a rotatable shaft, a propeller hub having a pair of aligned sockets, said hub being drivably connected with said shaft, a propeller blade rotatably mounted in each of said sockets, said hub being movable axially of said shaft in response to the thrust of the blades, resilient means for yieldably opposing such movement of the hub, and means comprising link mechanisms interconnecting said blades with said shaft rearwardly of the propeller, said mechanisms being effective during axial movement of the hub in response to the thrust of the blades to vary the pitch of the latter.

13. In an aeronautical propeller having a rotatable shaft, a hub drivably connected with the shaft, a plurality of sleeves rotatably mounted in the hub, each of said sleeves having enlarged portions upon diametrically opposite sides, propeller blades having their root ends secured within said sleeves, said hub being relatively movable with respect to said shaft, and means for varying the pitch of said blades during relative movement of the hub with respect to the shaft comprising a plate member secured to the shaft rearwardly of the propeller, a stud secured to each of said sleeves, and links interconnecting said plate member with said studs, said enlarged portions being subject to centrifugal force during operation of the propeller for substantially neutralizing the torsion of the blades.

14. A propeller of the class described comprising a hub, a plurality of blades rotatably carried thereby, means for driving said hub, said hub being relatively movable with respect to said driving means in response to the thrust of said blades, relatively stationary means including a link secured to the driving means rearwardly of the propeller to rotate said blades with respect to the hub to change the pitch thereof during thrust-responsive movement of the hub with respect to the driving means, and weighted members associated with said blades for partially compensating for the torsion of the latter.

15. In combination with a propeller including a rotatable shaft, blades longitudinally movable with respect to the axis of said shaft and rotatable with respect to the axis of the blades, thrust-

responsive means including link mechanisms, one end of said mechanisms being connected to the blades and the other ends of said mechanisms being connected to said shaft rearwardly of the propeller for automatically causing rotation of the blades to vary the pitch, and means including weighted members for partially compensating for the torsion of the blades.

16. A propeller of the class described comprising a hub, a plurality of blades carried thereby, means for driving said hub, said hub being relatively movable with respect to said driving means in response to the thrust of said blades, a plurality of resilient members for yieldably opposing the movement of the hub with respect to the driving means, a plate secured to the driving means rearwardly of the hub, means interconnecting said plate with said blades to rotate the latter with respect to the hub to change the pitch during relative movement of the hub with respect to the driving means, and means including centrifugally-responsive weighted members for partially compensating for the torsion of the blades.

MARTIN MANSSON.