Nov. 18, 1930. S. A. REED 1,781,883

AERONAUTICAL PROPELLER

Filed Oct. 29, 1929 2 Sheets-Sheet 1

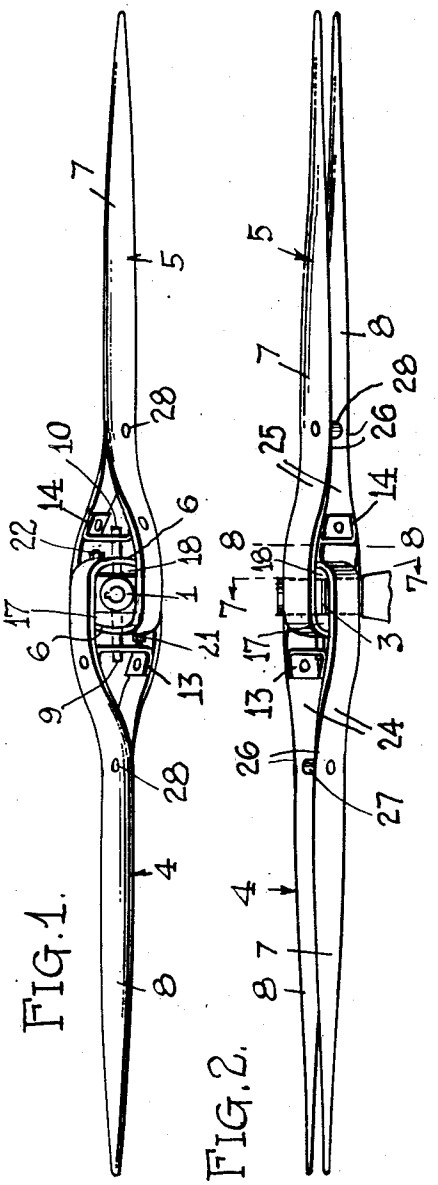


FIG. 1.

FIG. 2.

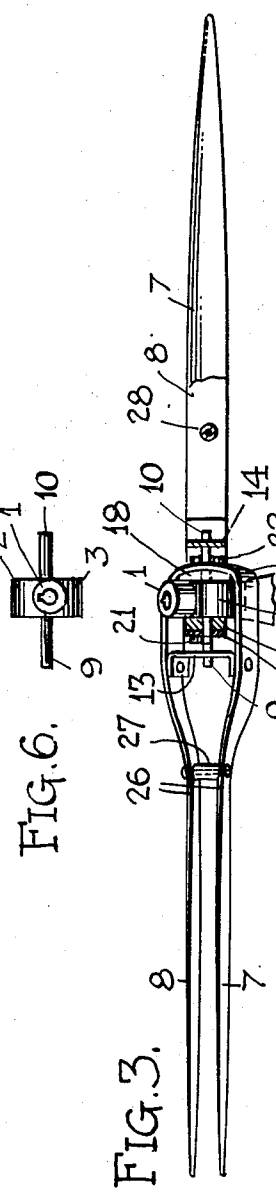


FIG. 3.

FIG. 6.

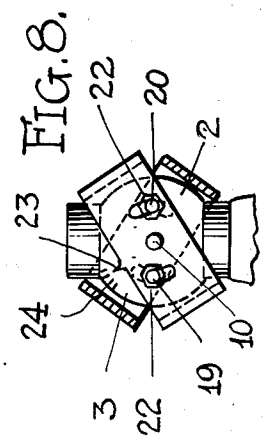


FIG. 8.

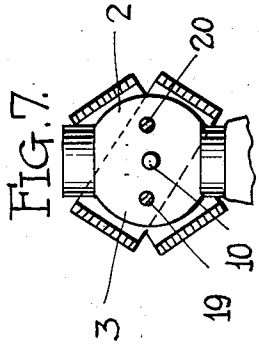


FIG. 7.

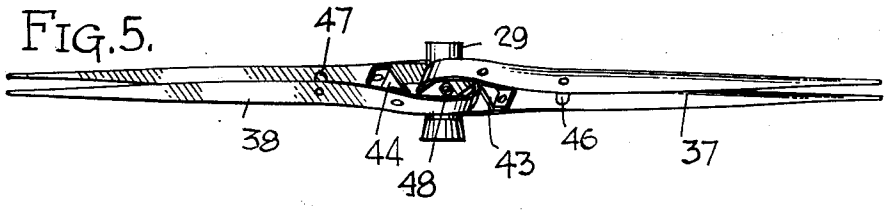
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FIG. 5.



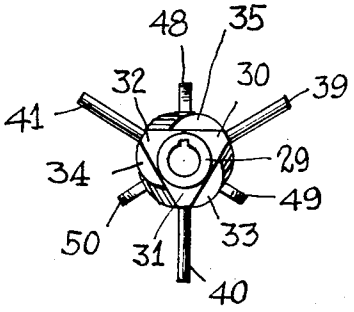


FIG. 9.

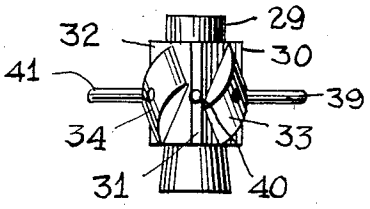


FIG. 10.

FIG. 4.

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Patented Nov. 18, 1930 1,781,883

UNITED STATES PATENT OFFICE

SYLVANUS A. REED, OF NEW YORK, N. Y., ASSIGNOR TO THE REED PROPELLER CO. INC., A CORPORATION OF NEW YORK

AERONAUTICAL PROPELLER

Application filed October 29, 1929. Serial No. 403,165.

My invention relates to aeronautical propellers of adjustable or variable pitch, especially when made of metal with solid blades, preferably forged and of one piece construction, and has for its object the reduction of the weight hitherto incident to such propellers, without increasing the unit stresses on the metal.

A further object of the invention is to dispense with junctions under heavy tensile or sharing stresses and at the same time simplify the construction.

The weight of the propeller is reduced by multiplying the blades in a manner similar to that described in my pending application Serial Number 327,764, wherein the blades are arranged in pairs in tandem formation. The tandem blades comprising each pair are preferably looped, i. e., given a hairpin shape, and the two or more blade pairs then interlocked so as to engage and bear directly on the propeller hub unit. Thus arranged no connecting parts or junctions, called upon to undergo or sustain at any time heavy tensile or shearing stresses, are provided.

In the drawings:

Fig. 1 is a face or front view of the propeller of my invention as embodied in a so-called two-blade-pair type.

Fig. 2 is a plan view of the propeller of Fig. 1;

Fig. 3 is a similar view with the propeller turned and viewed from a different angle;

Fig. 4 is a face or front view of the propeller of my invention as embodied in a so-called three-blade-pair type;

Fig. 5 is a plan view of the propeller of Fig. 4;

Fig. 6 is a detail elevation of the hub of the two-blade-pair type;

Figs. 7 and 8 are enlarged sections on the line 7—7 and 8—8 respectively of Fig. 3;

Fig. 9 is a face or end view of the hub unit required for a three-blade-pair type propeller, and

Fig. 10 is a side elevation of the hub unit of Fig. 9.

In the embodiment of the invention selected for illustration two typical propeller assemblies, viz., one a two-blade-pair type, and the other a three-blade-pair type, are shown.

Referring to Figs. 1, 2, 3, 6, 7, and 8, wherein the two-blade-pair type is illustrated, 1 is a hub having formed integrally therewith, and on opposite sides thereof, fins 2, 3 for transmission of rotary motion from the engine to the propeller blades. 4, 5 are blade pairs, each having a loop 6, and substantially parallel blades or legs 7, 8, making a hairpin shape, the blades or legs being in tandem and spaced apart preferably a blade width at approximately mid-radius. 9, 10 are pins on the hub about which the blade pairs 4, 5 pivot. These pins extend radially out from the hubs substantially parallel with the longitudinal axes of the blades. Holes in the centers of the loops 6, thru which the pins 9, 10 are carried, permit rotation of the blade pairs to adjust or change their pitch angle. A five degree variation in pitch angle is sufficient for most, if not all, changes of pitch occurring in actual service.

Yokes 13, 14 are attached to and extend from one to the other of the blades of a pair, and have formed therein openings thru which the pivot pins 9, 10 extend. 17, 18 are blocks or cushions (preferably light metal) interposed between the hub fins or hub and the loop ends 6 of the blades. On one face, the cushions 17, 18 are flat to conform to the hub or fin surfaces, whereas on their opposite faces they are curved to conform to the curvature of the loops. The yokes are provided to hold the blade pairs in radial position and are shaped to rigidly hold the blade roots against torsion.

Bolts 19, 20 lying substantially in the main plane of rotation of the propeller pass thru both loops 6, the fins 2, 3 and the cushions 17, 18, one on each side of the hub, to hold the blade pairs in fixed position radially. The holes in the loops and cushions thru which the bolts 19, 20 pass are slotted on an arc around the pivot pins 9, 10, whereas the bolt holes in the fins 2, 3 are unslotted. The slotted holes permit rotation of the loops and hence the blade pairs, for a few degrees about the pivot pins 9, 10 in obtaining pitch ad-

justment. Nuts 21, 22 on the bolts 19, 20 hold the blade pairs in place.

An indicator or index 23 is attached to each loop 6 and is adapted to play around an arc scale 24 to accurately determine and indicate the angular pitch setting of the blades. I may, however, use any other convenient form of device for determining the pitch setting.

In order that each blade or leg of a pair shall be substantially in a radial line, and therefore subject only to normal deflection stresses while in rapid motion, I prefer to bend the blades edgewise as shown at 24, 25 in Fig. 2, which bending results in giving to the blades the desired radial attitude beyond the points marked 26. At or near said points 26 interblade ties 27, 28 are provided. These ties 27, 28 are preferably fastened near the leading edge of the rear blade and near the trailing edge of the forward blade and cooperate with the yokes 13, 14 to effectively brace and fortify the blade pairs against change of pitch angle and flutter. Moreover, this angular stabilizing function of the inter-ties 27, 28 near the blade roots, makes it possible to materially reduce the mass of the blade roots which otherwise would be needed for angle stabilization, and is an important weight reducing factor of the invention. Generally, the function of the inter-ties is similar to that described in said co-pending application, but is associated here with the particular edgewise bending of the tandem blades.

Referring to Figs. 4, 5, 9, and 10, the blade pairs are disposed in what may be termed a three-fold arrangement, making a six blade or six leg tandem propeller in which the hub 29 has three fins 30, 31, and 32 instead of two, and in which the blade cushions 33, 34 and 35 are similar to those above described in the case of the four-leg tandem type. In said Figs. 4, 5, 9, and 10, the three-blade-pairs are designated as 36, 37, and 38, and the radial pins or pivots about which they rotate are designated as 39, 40, and 41. The pins, as in the two-blade-pair type propeller, pass thru the yokes 42, 43, and 44 as well as thru the inner blade loops and the blade pairs are axially adjustable to secure pitch angle change. Also, as in the two-blade type, inter-blade ties 45, 46, and 47 are provided as well as bolts 48, 49 and 50 for fastening the blade pairs to the hub unit.

Obviously, if desired, more than three pairs of blades may be disposed in interlocking relation, hooked around the hub, and except for the difference in number of such blade pairs, the construction of the propeller would be generally similar.

While I have described my invention in detail in its present preferred embodiment, it will be obvious to those skilled in the art after understanding my invention, that various changes and modifications may be made therein without departing from the spirit or scope thereof. I aim in the appended claims to cover all such modifications and changes.

What I claim is:

1. A metal aeronautical propeller including a hub unit and two or more blade pairs, the blade pairs in each instance being substantially hairpin shaped with the loop end of each pair bearing on and passing around said hub.

2. A metal aeronautical propeller including a hub unit and two or more blade pairs, the blade pairs being of substantially hairpin shape having interlocking loop ends which bear on and pass around said hub.

3. A metal aeronautical propeller including a hub unit and two or more pairs of substantially similar blades, each pair being of one piece construction and forming a loop of hairpin shape with legs substantially parallel and in tandem; each loop bearing on and passing around said hub.

4. A metal aeronautical propeller including a hub unit and two or more pairs of substantially similar blades, each pair being of one piece construction and forming a loop of hairpin shape with legs substantially parallel and in tandem; the loop of one blade pair interlocking with that of another, and each loop bearing on and passing around said hub.

5. A metal aeronautical propeller including a hub unit and two or more structurally solid and integral tandem blade pairs, each pair being a unit loop hooking around and pivoted on said hub for pitch changing rotation about a radial axis.

6. A metal aeronautical propeller including a hub unit and two or more structurally solid and integral tandem blade pairs, each pair being a unit loop hooking around and pivoted on said hub for pitch changing rotation about a radial axis, and an adjustment means for fastening the blade pairs at the desired pitch angle setting.

7. A metal aeronautical propeller, including a hub unit and two or more integral tandem blade pairs, each pair being a unit loop hooking around and pivoted at the center of the loop on said hub for pitch changing rotation about a radial axis, and means rigidly connecting the tandem legs of each blade pair adjacent to but on the opposite side of the hub from said loop.

8. A metal aeronautical propeller, a hub unit and two or more integral tandem blade pairs, each blade pair being a unit loop hooking around and pivoted at the center of the loop on said hub for pitch changing rotation about a substantially radial axis, means rigidly connecting the tandem legs of each blade pair adjacent to but on the opposite side of the hub unit from said loop, and an adjusting means for fastening the blade pairs at the desired pitch angle setting.

9. A metal aeronautical propeller including a hub unit, pivot pins extending radially out from said hub unit, integral tandem blade pairs mounted on said pins to rotate about substantially radial axes, said blade pairs being carried by said hub and being of one piece construction and forming a loop of hairpin shape thru which said pins extend, and means rigidly connecting the blades of each pair adjacent to but on the opposite side of said hub from said loop, said last mentioned means being also engaged by said radial pins.

10. A metal aeronautical propeller including a hub unit, pivot pins extending radially out from said hub unit, integral tandem blade pairs extending radially out from said hub unit, said blade pairs being looped at their inner ends to pass around said hub unit and having openings formed in said loop portions thru which said pins extend whereby the tandem pairs of blades may be rotated to secure pitch adjustment, and means for clamping the tandem blades in fixed relation to said hub.

11. A metal aeronautical propeller including a hub unit, and extending radially out therefrom two or more tandem blade pairs, the blade pairs in each instance being formed from a single length of metal bent intermediately of its ends for attachment at said bend to said hub.

12. A metal aeronautical propeller including a hub unit, and extending radially out therefrom two or more tandem blade pairs, the blade pairs in each instance being formed of a single length of metal bent intermediately of its ends to interlock, at said hub unit, with one or more of the remaining tandem pairs.

13. A metal aeronautical propeller including a hub unit, and extending radially out therefrom two or more tandem blade pairs having substantially parallel outer end portions and inwardly divergent inner end portions, the blade pairs in each instance being formed in one piece with a loop end bearing on said hub, and an inter-tie between said parallel blade portions substantially at the point where the inward divergence begins.

14. A metal aeronautical propeller including a hub unit, and extending radially out therefrom two or more tandem blade pairs which, throughout the greater portion of the length of the legs thereof are substantially parallel, the legs, at their inner ends, being united by an integral loop fastened to said hub, and an inter-tie extending from one to the other of the blade legs at a point radially out from said hub.

15. A metal aeronautical propeller including a hub unit and two or more integral tandem blade pairs, each pair being a unit loop hooking around said hub at its inner end and means rigidly connecting in tandem legs of each blade pair adjacent to but on the opposite side of the hub from said loop, said blade pairs being pivotally mounted for rotation about a substantially radial axis for pitch adjustment, and the pivot axes being carried thru both the loop ends of the blade pairs as well as thru the blade connecting means last mentioned.

In testimony whereof I hereunto affix my signature.

SYLVANUS A. REED.