D. G. HARKINS.

AEROPLANE PROPELLER.

APPLICATION FILED FEB. 28, 1921.

1,407,271.

Patented Feb. 21, 1922.

3 SHEETS—SHEET 1.

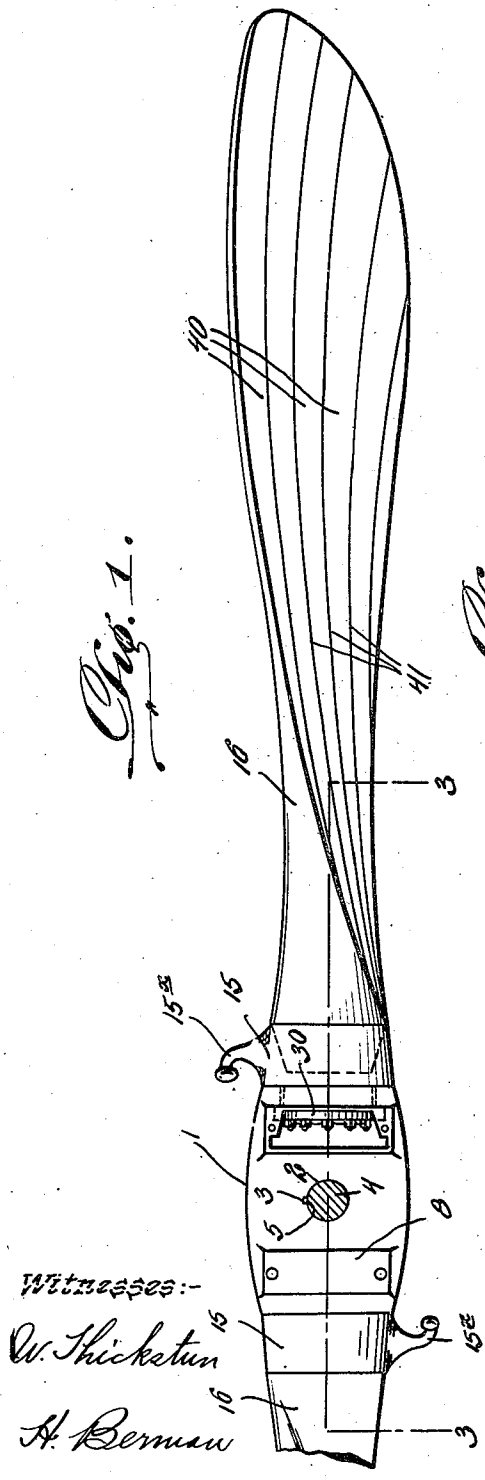


Fig. 1.

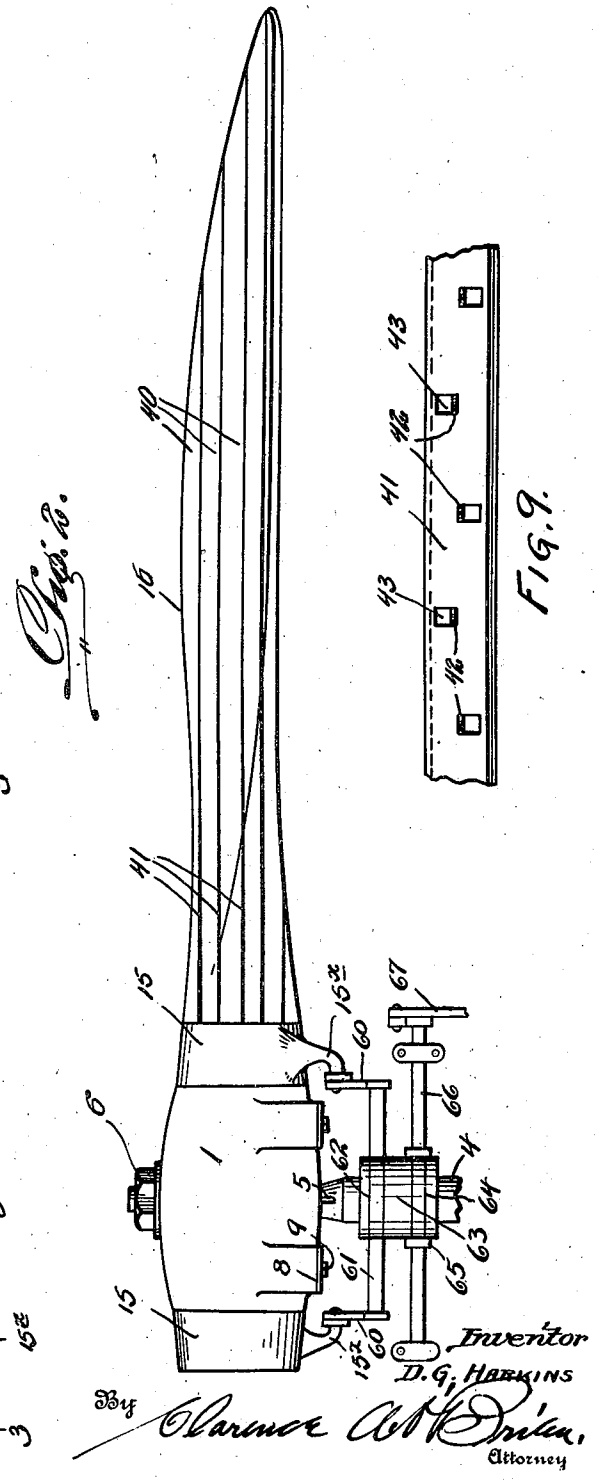


Fig. 2.

FIG. 9.

Witnesses:-

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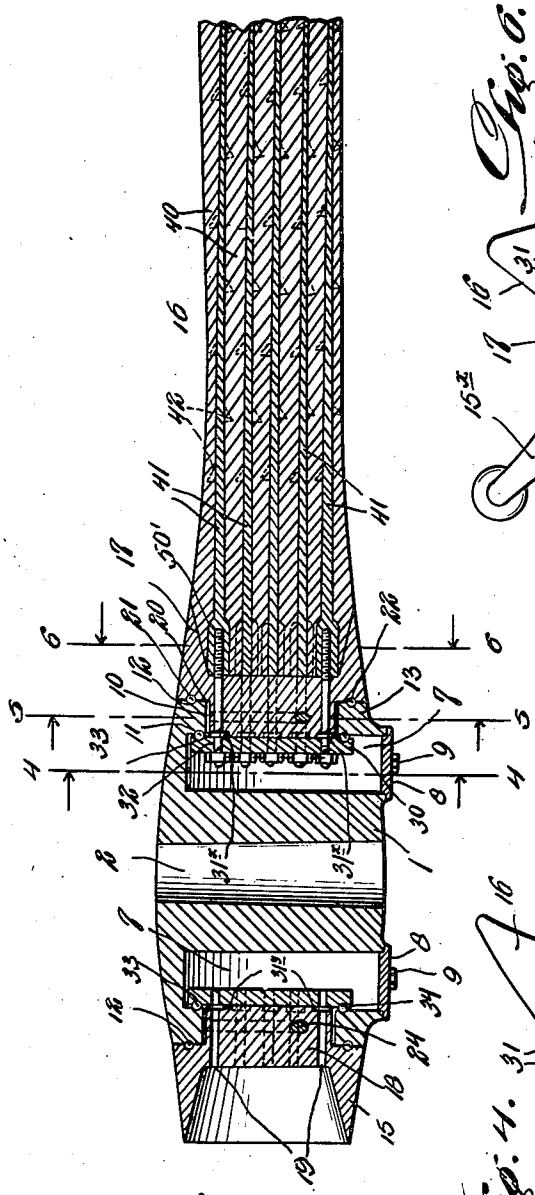


Fig. 3.

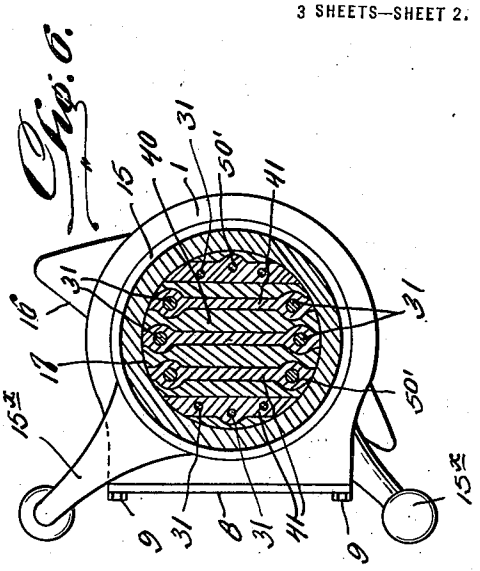


Fig. 6.

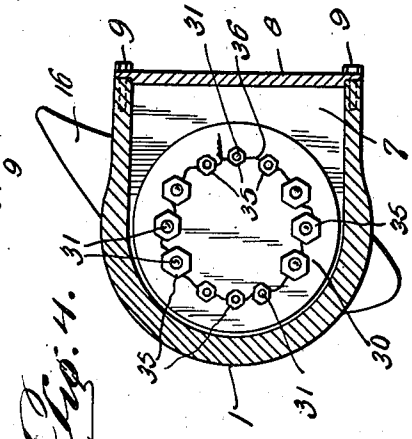


Fig. 4.

Witnesses:-

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3 SHEETS—SHEET 3.

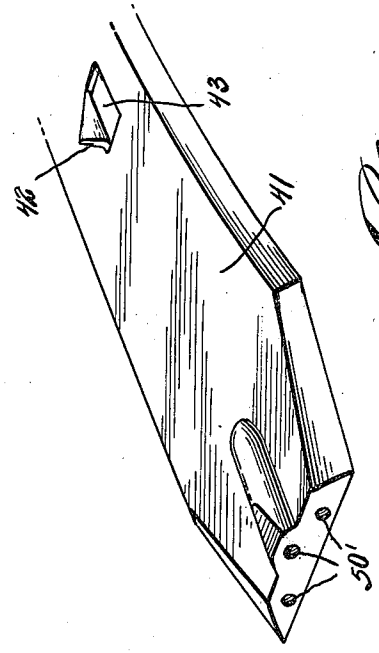


Fig. 6.

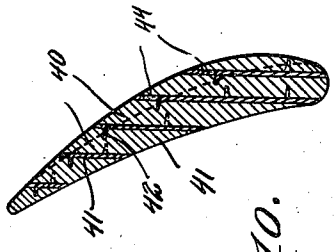


Fig. 10.

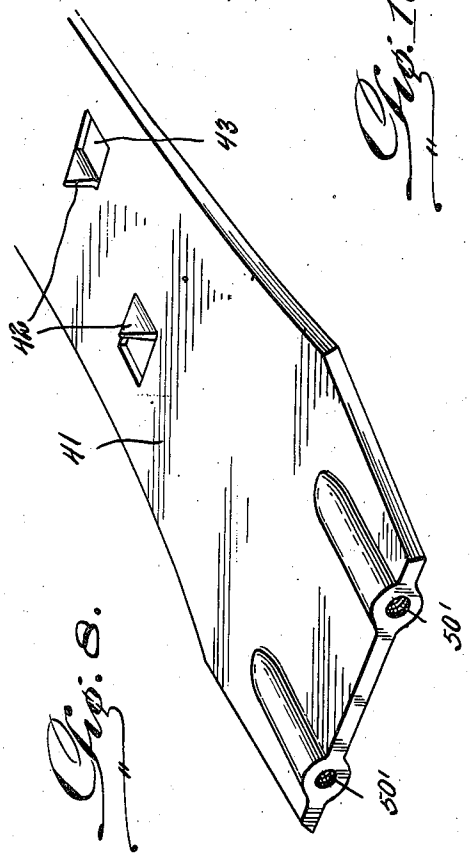


Fig. 8.

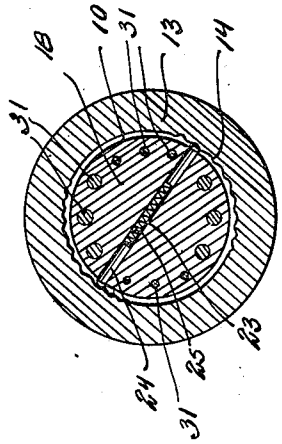


Fig. 5.

Witnesses:-

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UNITED STATES PATENT OFFICE.

DONALD G. HARKINS, OF CANTON, NORTH CAROLINA.

AEROPLANE PROPELLER.

1,407,271. Specification of Letters Patent. Patented Feb. 21, 1922.

Application filed February 28, 1921. Serial No. 448,514.

To all whom it may concern:

Be it known that I, DONALD G. HARKINS, a citizen of the United States, residing at Canton, in the county of Haywood and State of North Carolina, have invented new and useful Improvements in Aeroplane Propellers, of which the following is a specification.

One object of my present invention is the provision of an aeroplane blade formed of wood and metal in laminated fashion and in such manner that the blade is, at once, light in weight and strong, and, therefore, well adapted to withstand the usage to which aeroplane propeller blades are ordinarily subjected.

Another object is the provision of an aeroplane propeller blade mounted in improved manner for turning of the blade about its axis and relatively to its hub without diminishing the strength of the connection between the blade and hub.

Another object is the provision in an aeroplane propeller of improved means whereby the hub and the blades are connected together; the connections being of such character as to lend themselves to facility of assembly, strength and permanency.

To the attainment of the foregoing, the invention consists in the improvement as hereinafter described and definitely claimed.

In the accompanying drawings, forming part hereof:—

Figure 1 is an elevation of an aeroplane propeller constructed in accordance with my invention, with one of its blades partly broken away.

Figure 2 is a plan view of the same with one blade altogether omitted.

Figure 3 is a longitudinal section taken in the plane indicated by the line 3—3 of Figure 1.

Figures 4, 5 and 6 are cross sections on the lines 4—4, 5—5, and 6—6, respectively, of Figure 3.

Figure 7 is an enlarged perspective of the inner end portion of one of the outer metal plates of the improved blades.

Figure 8 is a similar view of one of the intermediate metal plates of the blades.

Figure 9 is a fragmentary perspective of one of the metal plates.

Figure 10 is a transverse section taken through one of the blades and showing the arrangement of the barbs of the interposed metallic plates relatively to the edges of the wooden laminations of the blade.

Similar numerals of reference designate corresponding parts in all of the views of the drawings.

The hub 1 is of metal and is provided with a taper bore 2 and a key-way 3 in the wall of the bore, to receive a crank shaft 4 and its key 5; the hub being secured on the shaft through the medium of a nut 6, Figure 2, or other appropriate means. In the end portions of the hub 1 and reaching to one side thereof, Figures 3 and 4, are chambers 7 which are closed at said side through the medium of closure plates 8, detachably connected to the hub through the medium of lag screws 9 or other appropriate means. In the ends of the hub and extending longitudinally outward from the chambers 7 are openings 10, of circular form in cross-section, which are surrounded by inner and outer circular grooves 11 and 12, formed in the walls 13 of said openings 10. It will also be noted by comparison of Figures 3 and 5 that opposite sets of shallow indentures 14 are formed in the walls 13.

The metallic heel members 15 of the blades 16 will be readily understood when it is stated that each of said members 15 is provided in its outer end with a blade socket 17, and each is provided with an inner end portion 18, circular in cross-section in the present embodiment, and arranged and adapted to be turned about its axis in one of the openings 10. A circular series of longitudinal bores 19 extends through each end portion 18, and each heel member 15 is provided in its shoulder 20 that is opposed to one end of the hub 1 with a circular groove 21 which serves with the groove 12 to form a raceway for anti-friction balls 22. It will also be noted by reference to Figures 3 and 5 that the portion 18 of each heel member 15 is provided with a diametrical bore 23 containing radially-movable plungers 24 between which is a coiled spring 25 which tends to thrust the said plungers 24 endwise outwardly and yieldingly maintain the rounded outer ends thereof in indentures 14 of the hub 1. This provision is made in order to avert casual rotation or change of position of the heel members 15 and blades 16 about their common axis. It will be understood, however, that when stress is applied to the

arms 15^x of the heel-members 15 to adjust the pitch of the blades 16, the cooperating indentures 14 and plungers 24 will not prevent turning of the heel-members 15 and blades 16 about their axis.

Any suitable means may be employed to adjust the pitch of the blades 16 through the medium of the arms 15^x such, for instance, as the means shown in Figure 2. This means will be readily undertsood when it is stated that the arms 15^x are pivotally connected with links 60; also, that said links 60 are pivotally connected with an annular member 61. The said annular member 61 is adapted to ride in a circumferential groove 62 formed in a slidable member 63 mounted on and movable longitudinally of the shaft 4. The slidable member 63 is also provided with a circumferential groove 64 spaced from the groove 62, and engaged with said groove 64 is a yoke 65 on which is a transverse rod 66 to which is connected an operating rod 67 designed to be under the control of an aviator.

In the hub chambers 7 are arranged the anchor plates 30, Figures 1, 3 and 4. Manifestly when the plates 8 are removed, said anchor plates 30 may be readily introduced edgewise into the chambers 7 and may then be shifted laterally toward the ends of the hub 1 to position them on the blade bolts 31, it being understood in this connection that each plate 30 has a circular series of apertures 32 for said purpose; that each plate 30 has a circular groove 33 in its outer side to cooperate with a groove 11 in forming a raceway for anti-friction balls 34; and that the inner ends of the bolts 31 are threaded for the engagement of nuts 35 which are preferably wired on the bolts as indicated by 36 to preclude their casual loosening or displacement.

Each of the blades 16 is made up of laminations or sections 40 of wood, and alternate or interposed plates 41 of steel or appropriate metal. The plates 41 have oppositely directed lateral barbs 42 struck from them, and these barbs 42 are so relatively arranged, Figure 10, as to rest at considerable distances from the edges of the wooden sections 40; this being desirable for the sake of strength. It will also be observed that the striking of the barbs 42 from the plates 41 affords transverse openings 43 in the plates for the reception of glue 44 through the medium of which adjoining wooden sections 40 are connected together and to the metallic plate 41 interposed between them. By comparison of Figures 6, 7 and 8 it will be understood that each of the outer plates 41 is provided with three comparatively small longitudinal threaded bores 50′ in its inner end portion, and each of the intermediate plates 41 is provided with two relatively large bores 50′. Said bores receive the outer threaded portions of the bolts 31 by which the blades 16 are secured in the heel members 15 and are connected to the anchor plates 30 and hence to the hub 1. The bolts 31 connect the blades to the heel members 15 without the assistance of the anchor plates 30, as will be understood when it is noted that the bolts 31 have collars 31^x seated in countersinks 31^y in the heel members 15 and at the outer sides of the anchor plates. This construction also permits of each blade and its heel member being withdrawn as a unit from the hub.

The large and small bolts 31 are preferably arranged in a circle as shown for the convenient wiring of the nuts thereon, Figure 4.

In Figures 11, 12, 13 and 14 I show one means for adjusting the blades 16 about a common center and adjustably fixing the same. By particular reference to Figures 11 and 14 it will be understood that coupled to the arms 15^x and extending rearwardly therefrom are connecting rods 60, the rear end portions of which are coupled to a cross-head 70. The web 71 of the cross-head 70 is keyed on the shaft 4 as is also an annular disk 72 that is opposed to the rear side of the said web 71. Keyed on the shaft 4 in rear of the cross-head 70 is a sleeve 73 with a flange 74 at its forward end; said flange 74 being opposed to the front side of the web 71 to receive headed and threaded screws 75 which extend through the disk 72 and web 71 and strongly connect the same together and to the flange 74. It will be manifest from the foregoing that the cross-head 70 and the sleeve 73 and the parts connected therewith are susceptible of adjustment endwise of the shaft 4, notwithstanding they are caused in all positions to positively turn with the shaft when the latter is rotated.

The sleeve 73 is exteriorly of circular form in cross-section, and loosely receiving the said sleeve are collars 76 and 78 with opposed and spaced flanges 79 on their inner portions. Interposed between the collars 76 and 78 and loosely receiving the sleeve 73 and the collar flanges 79 is a cross-head 80. The said cross-head 80 does not rotate but is designed to be manipulated for the adjustment of the sleeve 73 lengthwise of the shaft 4. Surrounding the sleeve 73 in rear of the collar 78 is a collar 81 which is backed by an adjustable member 82 through the medium of which wear may be taken up when occasion demands. The said adjustable member 82 is threaded at 83 on the rear end portion of the sleeve 73, and is held against casual movement or loosening by a locking plate 84, detachably connected at 85 to the sleeve 73 and designed to be disposed in one of the circular series

of recesses 86, provided in the rear face of the member 82. Arranged in a race between the disk 72 and the collar 81 are anti-friction balls 87, and similarly arranged in a race between the collar 78 and the collar 81 are anti-friction balls 88. At its ends the cross-head 80 is coupled to the forward end portions of connecting rods 89. The rear end portions of said rods 89 are coupled to the ends of a rod 90, Figure 11, which is connected through the medium of a link 91 with a hand lever 92, fulcrumed at 93 on the fuselage of the aeroplane. The said lever 92 is equipped with a detent 94 for cooperation with a segmental rack 95 fixed on the fuselage. This provision is designed to enable an aviator to first adjust the blades about their common axis, and then adjustably fix said blades.

When the propeller blades are positioned as illustrated relatively to the hub 1 and shaft 4, forward power will be afforded as is desirable when "taking off" or when in flight. When less power is desired as when touching the ground in landing, the arms 15^x are moved forwardly, Figure 2. In the illustrated example when the arms 15^x are moved forwardly by means such as hereinbefore indicated through ninety degrees, the pitch of the blades 16 will be changed to the extent of ninety degrees to afford a push instead of a pull.

Having described my invention, what I claim and desire to secure by Letters-Patent, is:—

1. An aeroplane propeller blade comprising wooden sections, and interposed metallic plates having barbs embedded in said sections.

2. An aeroplane propeller blade comprising wooden sections, and interposed metallic plates having barbs embedded in said sections and also having openings for the reception of glue between the wooden sections.

3. An aeroplane propeller blade comprising wooden sections, and interposed metallic plates having barbs embedded in said sections and also having openings for the reception of glue between the wooden sections; said barbs struck from the plates whereby openings are formed in the plates for the reception of glue interposed between the wooden sections.

4. An aeroplane propeller blade comprising wooden sections, and interposed metallic plates having barbs embedded in said sections and also having openings for the reception of glue between the wooden sections; the said barbs being arranged remote from the edges of the wooden sections and therefore in the strongest portions of said sections.

5. An aeroplane propeller blade comprising wooden sections, and metallic plates interposed between and connected with the wooden sections and having longitudinal bolts at their inner ends and extending longitudinally beyond the inner end of the blade.

6. An aeroplane propeller blade comprising wooden sections, and metallic plates interposed between and connected with the wooden sections and having longitudinal bolts at their inner ends and extending longitudinally beyond the inner end of the blade; said bolts being threaded in longitudinal threaded bores in the inner end portions of the plates.

7. An aeroplane propeller blade comprising wooden sections, and metallic plates interposed between and connected with the wooden sections and having longitudinal bolts at their inner ends and extending longitudinally beyond the inner end of the blade; said bolts being threaded in longitudinal threaded bores in the inner end portions of the plates, and the outer plates being each provided with small bores and bolts, and the intermediate plates being each provided with a plurality of large bores and bolts.

8. An aeroplane propeller blade comprising wooden sections, and metallic plates interposed between and connected with the wooden sections and having longitudinal bolts at their inner ends and extending longitudinally beyond the inner end of the blade, in combination with a heel member having a socket receiving the inner end portion of the blade and also having longitudinal bores extending inwardly from said socket and receiving the bolts, and means on the inner end portions of the bolts, anchoring the blade to the heel member.

9. An aeroplane propeller blade comprising wooden sections, and metallic plates interposed between and connected with the wooden sections and having longitudinal bolts at their inner ends and extending longitudinally beyond the inner end of the blade, in combination with a heel member having a socket receiving the inner end portion of the blade and also having longitudinal bores extending inwardly from said socket and receiving the bolts, means on the inner end portions of the bolts, anchoring the blade to the heel member, the hub receiving the inner portion of the heel member and cooperating with said anchoring means in holding the heel member and blade to the hub.

10. An aeroplane propeller blade comprising wooden sections, and metallic plates interposed between and connected with the wooden sections and having longitudinal bolts at their inner ends and extending longitudinally beyond the inner end of the blade, in combination with a heel member having a socket receiving the inner end portion of the blade and also having longitudinal bores

extending inwardly from said socket and receiving the bolts, means on the inner end portions of the bolts, anchoring the blade to the heel member, the hub receiving the inner portion of the heel member and cooperating with said anchoring means in holding the heel member and blade to the hub; the anchoring means being in the form of a plate receiving the bolts and secured thereon, and the hub having a chamber extending to one of its sides for the introduction of said plate and also having means to normally close said chamber.

11. An aeroplane propeller blade comprising wooden sections, and metallic plates interposed between and connected with the wooden sections and having longitudinal bolts at their inner ends and extending longitudinally beyond the inner end of the blade, in combination with a heel member having a socket receiving the inner end portion of the blade and also having longitudinal bores extending inwardly from said socket and receiving the bolts, means on the inner end portions of the bolts, anchoring the blade to the heel member, the hub receiving the inner portion of the heel member and cooperating with said anchoring means in holding the heel member and blade to the hub; the said inner portion of the heel member and the hub bore being of circular cross-section, and the heel member being provided with means for the turning thereof about its axis.

12. An aeroplane propeller blade comprising wooden sections, and metallic plates interposed between and connected with the wooden sections and having longitudinal bolts at their inner ends and extending longitudinally beyond the inner end of the blade, in combination with a heel member having a socket receiving the inner end portion of the blade and also having longitudinal bores extending inwardly from said socket and receiving the bolts, means on the inner end portions of the bolts, anchoring the blade to the heel member, the hub receiving the inner portion of the heel member and cooperating with said anchoring means in holding the heel member and blade to the hub; the said inner portion of the heel member and the hub bore being of circular cross-section for the turning of said heel member and blade about their axis, and the heel member being provided with a spring-pressed detent, and the bore wall of the hub with shallow indentures to prevent turning of the heel member and blade except when said heel member is subjected to stress.

13. An aeroplane propeller comprising a hub, a plate, a heel member carried by the blade and journaled to turn about its axis in the hub, and yielding means cooperating with the heel member and hub to prevent turning of the blade and heel member except when the latter is subjected to stress.

14. In an aeroplane propeller, the combination of a hub having a chamber reaching to one of its sides and also having a bore, detachable means normally closing said chamber, an apertured anchor plate in the chamber, a heel member having a socket, a shoulder and an apertured inner portion, the latter occupying the hub bore, anti-friction means between the hub and the anchor plate, anti-friction means between the hub and the shoulder of the heel member, and a blade socketed in the heel member and having bolts extending therethrough and secured to the anchor plate.

15. An aeroplane propeller blade comprising wooden sections, and metallic plates interposed between and connected with the wooden sections and having longitudinal bolts at their inner ends and extending longitudinally beyond the inner end of the blade, in combination with a heel member having a socket receiving the inner end portion of the blade and also having longitudinal bores extending inwardly from said socket and receiving the bolts, and means on the inner end portions of the bolts, anchoring the blade to the heel member; the heel member having countersinks in its inner end, and the bolts having enlargements disposed in said countersinks.

In testimony whereof, I affix my signature.

DONALD G. HARKINS.