

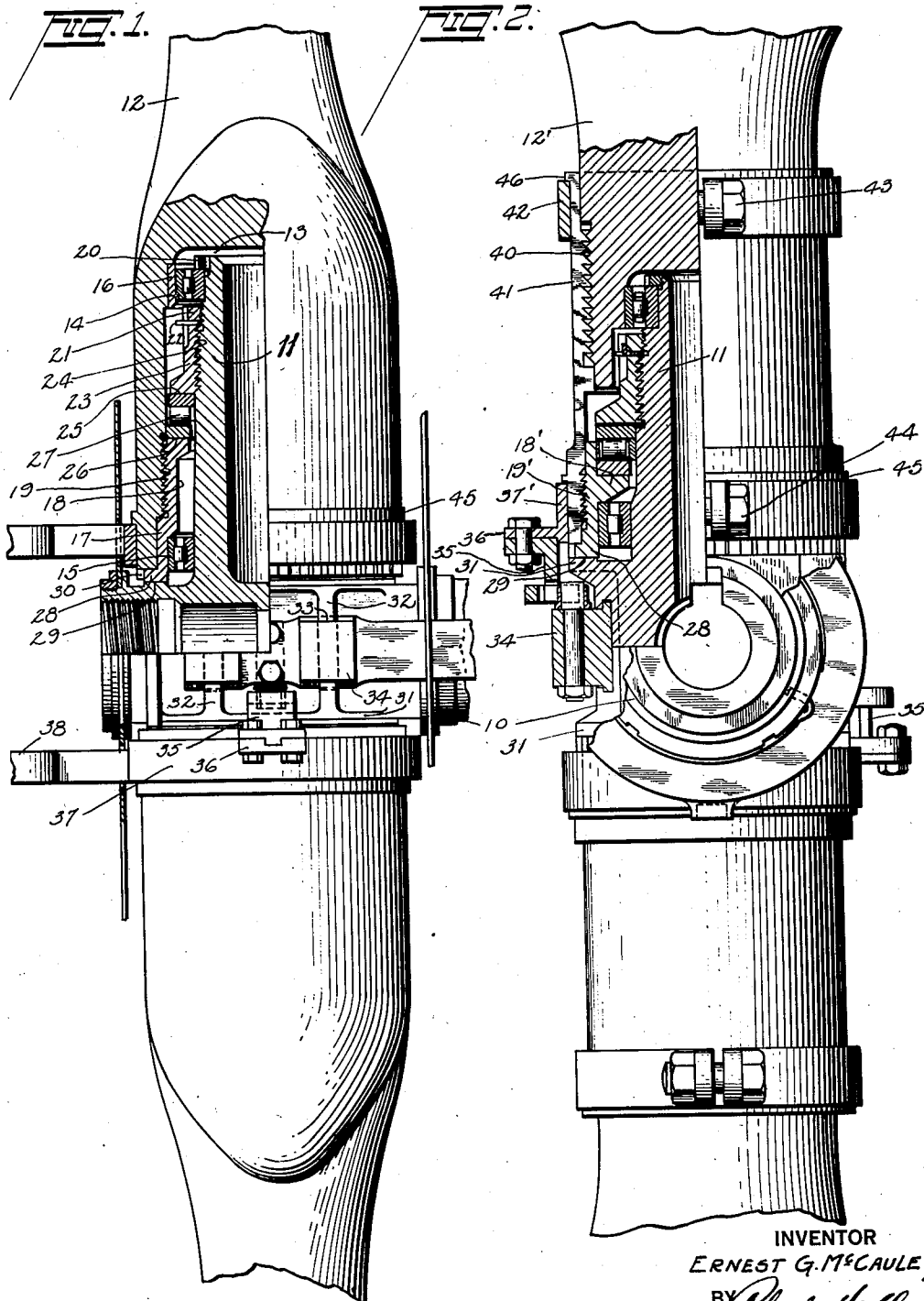
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AIRPLANE PROPELLER

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AIRPLANE PROPELLER

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This invention relates to airplane propellers generally, and is particularly concerned with the provision of an especially sturdy mounting for the propeller blades on the hub.

The principal object of the invention is to provide a bearing surface or abutment for the root end of the propeller blade laterally with respect to a spindle on the hub on which the blade is mounted, which will assume the thrust otherwise resulting in abnormal deflection of the spindle, when the blade flutters or is otherwise under extraordinary load.

Another object of the invention is to provide a blade mounting incorporating the feature above described in adjustable and reversible pitch propellers.

A still further object consists in the adaptation of the invention to use in connection with metallic, composition, or wooden blades all of which involve different constructions of the root end of the blade.

Other objects and advantages of my invention will appear in the following specification and claims. The invention is illustrated in the accompanying drawings, wherein

Figure 1 is a view partly in central longitudinal-section and partly in elevation of a propeller embodying my improved construction.

Fig. 2 is a similar view of another embodiment of the invention but looking at the propeller from the rear side instead of from the top as is the case in Fig. 1.

In the two views the same or similar reference numerals are applied to corresponding parts.

In propeller constructions of the type heretofore used, and more particularly in the case of adjustable and reversible pitch propellers, where a hollow ended blade was revolvably mounted on a spindle extending from the hub, the terrific stress set up at the base of the spindle under extremely heavy

loading of the propeller blade, or when the blade fluttered, was often sufficient to result in a failure at the juncture of the spindle and hub. It is therefore the main object of my invention to provide a solid bearing or abutment between the blade and the hub about the base of the spindle and preferably as far removed from the spindle as the diameter of the root end of the blade permits with a view to assuming the stress above mentioned by the blade end bearing against the hub. Any fluttering or abnormal deflection of the blade does not in this way effect a similar deflection of the spindle support but is accommodated throughout the length of the blade and thus cannot result in a failure.

While the invention has particular utility in connection with adjustable and reversible pitch propellers, where the mounting invariably includes a spindle and where the blade end has no fixed connection at the hub in order that it might be rotated on its spindle, the invention is likewise adaptable to fixed and semi-adjustable propellers in which case the bearing or abutment at the hub is even more effective since there need not be any tolerance for the blade turning relative to the hub and the end of the blade may be jammed in tight contact with the hub throughout the diameter of the root end of the blade.

Referring now to the drawing and more particularly to Fig. 1, the hub 10 is of the usual form having a tapered bore to receive the tapered end of the engine shaft on which the propeller is mounted. Extending in opposite directions from the hub are hollow spindles 11 for mounting the propeller blades 12. The blade illustrated is made of duralumin or other metal and has a hollow root end as indicated at 13, to fit over the spindle and have connection therewith. A rotary antifriction bearing 14 is provided at the outer end of the spindle 11 between the blade

and the spindle and another similar bearing 15 is provided at the base of the spindle. A suitable race ring 16 is provided inside the blade 12 for the bearing 14 and another race is provided at 17 for the bearing 15 on a sleeve 18 threaded inside the blade 12 in the buttress threads 19. The bearing 14 is suitably backed up by a nut 20 threading onto the end of the spindle 11. Another nut 21 backs up and locks with a washer 22, a collar 23 threading on buttress threads 24 on the spindle 11. The collar 23 has a thrust bearing end 25 which cooperates with a thrust bearing end 26 on the sleeve 18, there being a suitable antifriction thrust bearing 27 interposed between the ends of the collar 23 and sleeve 18 as shown. The bearing 27 assumes the end thrust due to centrifugal force of the blade relative to the spindle in operation while the bearings 14 and 15 permit rotation of the blade on the spindle in the adjusting or reversing of the pitch of the propeller. The details thus far described form no particular part of my present invention, but are illustrated and described in view of their association with the features of the present invention to which I have generally referred above.

In previous constructions the sleeve 18 stopped short of the hub, leaving an appreciable clearance between the root end of the blade and the hub. I have illustrated the sleeve 18 as provided with a bearing end 28 resting in flush engagement with a seat 29 provided on the hub 10 about the base of the spindle 11 and displaced therefrom an appreciable distance as shown. The bearing end 28 has the periphery thereof notched to provide lugs 30, between which the jaws of a spanner wrench may be engaged in threading the blade on the sleeve. The seat 29 constitutes the front face of a flange 31 built up from the hub 10 at the base of each of the spindles 11. When extraordinary heavy strain is set up and the spindle would otherwise be subjected to sufficient deflection to result even in failure at the base of the spindle, the load is assumed by the engagement of the bearing 28 at the end of the blade 12 on the seat 29. In the assembling of the blade the thrust collar 23 is drawn up to a point where only a very slight but perceptible looseness is left between the bearing 28 and the seat 29 to enable turning the blade on the spindle to adjust or reverse the pitch of the propeller. It will be understood that the centrifugal forces communicating an end thrust to the blade outwardly relative to the spindle will afford additional slight clearance in the operation of the propeller so that it is relatively easy to turn the blade on the spindle. At the same time the feature of having the root end of the blade bearing on the hub comes into play when an extraordinary heavy strain is set up by a flut-

tering of the propeller or other deflection thereof under heavy loading.

The flanges 31 are suitably reinforced by ribs 32 extending across the hub 10 between the flanges as shown. These ribs afford guides at 33 for reciprocable heads 34 slidable operating lengthwise of the hub 10 on opposite sides, and having pivotal connection through yokes 35 with the propeller blades. Each of the yokes 35 is attached to a lug 36 on a collar 37 fixed on the end of the blade 12 and has a counterweight 38 integral therewith and extending forwardly therefrom. It will be seen that with the heads 34 connected on opposite sides of the hub 10 with the opposite blades of the propeller, the blades are given simultaneous rotary adjustment in opposite directions on their axes relative to the spindles 11 as the heads 34 are moved laterally therewith. The counterweights as described in an earlier application, Serial Number 560,673 filed May 13, 1922, now Patent No. 1,658,385 issued February 7, 1927, maintain exact dynamic balance for the propeller in all states of adjustment of the blades.

In Fig. 2 another form of my invention is illustrated showing the application to micarta, wooden or other propeller blades, which necessitate somewhat different constructions at their root ends in mounting the blades on the spindles. The blade 12' has buttress ridges and grooves 40 to receive complementary internal buttress ridges and grooves in a split ferrule 41, the halves of which are placed together about the end of the blade and held in assembled relation thereon by a clamping band 42, the free ends of which are bolted together as shown at 43. The halves of the ferrule 41 also embrace a sleeve 18', the periphery of which has buttress ridges and grooves 19' received in complementary internal buttress ridges and grooves in the inner end of the ferrule 41. The halves of the ferrule 41 are held together at their inner end by a clamping sleeve 37' the free ends of which are bolted together as indicated at 44. The sleeve 37' rests against an annular shoulder 45 on the ferrule 41 similarly as the sleeve 37 shown in Fig. 1. Clamping band 42 is also held in position by engagement with the annular shoulder 46 at the outer end of the ferrule 41. The sleeve 37' which it will be understood, carries a counterweight 38 similarly as the sleeve 37 in Fig. 1, likewise has a lug 36 through which connection is made by a yoke 35 with the reciprocating head 34 operating between the flanges 31 on the hub 10. The operation of this form of my invention is substantially the same as that shown in Fig. 1 with the exception that the clamping bands 42 in this instance constitute a means for securing static balance of the propeller similarly as described in a copending application #5,837 filed Jan. 30, 1930

1925, by rotating the bands to position the lugs and bolts thereof differently with respect to the blade axis or in certain instances to vary the position of a band itself to secure proper balance. In this instance, it will also be noted that the sleeve 37' being split constitutes a means for clamping the halves of the ferrule together to complete the mounting of the blade on the spindle 11. The bearing feature above described is carried out in a similar manner in this case by the bearing end 28 of the sleeve 18' resting in flush contact with the abutment or seat 29 about the base of the spindle 11.

15 I claim:

1. In a propeller, a hub having a spindle thereon, a blade mounted on said spindle and held central thereby, there being rotary bearings adjacent the outer and inner ends of said spindle to permit rotation of said blade relative to said spindle, a frictionless thrust bearing intermediate said rotary bearing to assume the end thrust of the blade relative to said spindle in operation, and an annular raised portion at said hub for the end of said blade to assume the stress otherwise communicated to the spindle due to lateral deflection of the blade under heavy load.

2. In a propeller, a hub having opposed spindles for mounting propeller blades, annular flanges on said hub providing annular seats at the base of the spindles, blades mounted on said spindles and having bearings engaging said seats, and reinforcements between said flanges.

3. In a propeller, a hub arranged to be mounted on an engine shaft and having spindles extending in opposite directions therefrom for mounting propeller blades, a pair of propeller blades mounted on said spindles, there being rotary bearings between said blades and said spindles to permit rotation of the blades on said spindles, thrust bearing means to assume the end thrust of said blades relative to said spindles in operation, a pair of flanges providing auxiliary thrust bearing surfaces at the base of the spindles on opposite sides of the hub, said blades having bearing portions at the root ends thereof engaging said surfaces, and reciprocable members having connections with said blades slidably operable on said hub and between said flanges for communicating opposite rotation to said blades relative to said spindle.

4. In a propeller, a hub arranged to be mounted on an engine shaft and having spindles extending in opposite directions therefrom for mounting propeller blades, a pair of propeller blades mounted on said spindles, there being rotary bearings between said blades and said spindles to permit rotation of the blades on said spindles, thrust bearing means to assume the end thrust of said blades relative to said spindles in opera-

tion, a pair of flanges providing auxiliary thrust bearing surfaces at the base of the spindles on opposite sides of the hub, said blades having bearing portions at the root ends thereof engaging said surfaces, ribs extending across said hub between said flanges for reinforcement, and reciprocable members operating in guides provided in said ribs between said flanges, said members having connections with said blades for communicating opposite rotation to said blades relative to said spindle.

5. In a propeller, a hub having a spindle, a blade having its end rotatably mounted thereon, a thrust collar adjustable on said spindle to vary the position of said blade endwise of said spindle, an annular seat at said hub for said blade, and an abutment member on said blade having one end bearing against said abutment and adjustable endwise relative to said blade.

6. In a propeller, a hub having a spindle, a blade having its end rotatably mounted thereon, a thrust collar adjustable on said spindle to vary the position of said blade endwise of said spindle, an annular seat at said hub for said blade, and an abutment member on said blade having one end bearing against said annular seat and adjustable endwise relative to said blade, the position of said thrust collar on said spindle determining the relation of said abutment member to said abutment.

7. In a propeller, a hub having a spindle, a blade having its end rotatably mounted thereon, a thrust collar adjustable on said spindle to vary the position of said blade endwise of said spindle, an annular seat on said hub for said blade, and an abutment member on said blade having one end bearing against said annular seat and adjustable endwise relative to said blade.

8. In a propeller, a hub having a spindle, a blade mounted on said spindle and means intermediate said hub and the root end of said blade forming a solid bearing portion therewith, said means comprising a flanged sleeve mounted on said blade and bearing against said hub.

9. In a propeller, a hub having a spindle thereon, a blade having a hollow end, rotatably mounted on said spindle, thrust bearing means comprising a frictionless bearing and a flanged member between said hub and blade, and an annular bearing on said hub forming an abutment for said flanged member.

10. In a propeller, a hub having a spindle thereon, a blade having a hollow end fitting over said spindle, rotary bearings between said spindle and said blade to permit rotation of said blade relative to said spindle, thrust bearing means between said spindle and said blade and an annular bearing por-

tion on said hub forming an abutment for said thrust bearing means.

11. In a propeller, a hub having a spindle thereon, a blade having a hollow end fitting over said spindle, rotary bearings between said spindle and said blade to permit rotation of said blade relative to said spindle, adjustable thrust bearing means between said spindle and said blade, and an annular bearing portion on said hub forming an abutment for said thrust bearing means and means for rotating said blade relative to said spindle.

12. In a propeller, a hub, annular seat on said hub, a blade rotatably mounted on said seat and adjusting means on said hub and within said blades for retaining said blade against said seat to prevent any deflection thereof.

13. In a controllable pitch propeller, a hub, an annular seat on said hub, a blade rotatably mounted on said seat, adjusting means on said hub and within said blade for retaining said blade against said seat to prevent any deflection thereof and means for changing the angular pitch of said blade.

14. In a propeller, a hub, an annular seat on said hub, an arm on said hub and concentric with said annular seat, a blade rotatably mounted on said arm and abutting said seat, and adjustable means within said blade for retaining said blade against said seat.

15. In a propeller, a hub provided with a spindle, a cylindrical flange on said hub at the base of said spindle, a sleeve mounted on said spindle and abutting against said flange, a blade detachably mounted on said sleeve and means for holding said sleeve and blade in alignment on said hub.

16. In a propeller, a hub provided with a spindle, a cylindrical flange on said hub at the base of said spindle, a sleeve mounted on said spindle and abutting against said flange, a blade detachably mounted on said sleeve, means for holding said sleeve and blade in alignment on said hub and means for adjusting the pitch of said blade.

17. In a propeller, a hub, a blade, and a ferrule thereon and an abutment for the root end of the ferrule on said hub.

18. In a propeller, a hub, a ferrule, a blade in said ferrule, and a bearing for the root end of said ferrule on said hub, said bearing being annularly concentric with the blade axis.

19. In a propeller, a hub having a spindle thereon, a ferrule having a blade mounted therein, and means forming an abutment about said spindle against which the end of said ferrule contacts.

20. In a propeller, a hub having a plurality of spindles, blades mounted on said spindles, said spindles having bearing portions for centrally locating the blades thereon, means intermediate said bearing portions for retaining said blades against endwise move-

ment, and additional means for clamping said blades in assembled position on said hub.

21. In a propeller, a hub having a plurality of spindles, blades mounted on said spindles, said spindles having bearing portions for centrally locating the blades thereon, means intermediate said bearing portions for retaining said blades against endwise movement, and additional means for clamping said blades in assembled position on said hub, said clamping means being revoluble around the blade's axis.

22. In a propeller, a hub having a plurality of spindles, blades mounted on said spindles, said spindles having bearing portions for centrally locating the blades thereon, threaded means intermediate said bearing portions for retaining said blades against endwise movement, and clamping means for holding said blades in relation to said threaded means.

23. In a propeller, a hub having spindles thereon, blades provided with hollow root ends, an annular seat for the root end of said blade on said hub, bearing means on said spindle contacting with similar bearings within the hollow root ends of said blades, and means intermediate said bearing means for retaining said blades against endwise movement, said retaining means tending to hold said blade against said annular seat and prevent lateral deflection of said blade.

24. In a propeller, a hub having a spindle, a blade mounted on said spindle and means intermediate said hub and root end of said blade, said means being connected with the blade and forming an abutment with said hub.

25. In a propeller, a hub having a plurality of spindles, blades mounted on said spindles, said spindles having bearing portions for centrally locating the blades thereon and adjustable clamping means externally mounted on said blades for retaining said blades against endwise movement in relation to said hub.

26. In a propeller, a hub, a blade, a split ferrule on said blade and adjustable clamping means mounted on said ferrule for securing said blade within said ferrule.

27. In a propeller, a hub having a spindle thereon, an abutment on the spindle for a thrust bearing, a blade, a split ferrule adapted to engage the shank of the blade, an adjustable abutment sleeve member adopted to be held inside the ferrule and to cooperate with the first abutment member to inclose a thrust bearing therebetween, a bearing between the sleeve and spindle, and detachable clamping rings for holding the ferrule members together on the inclosed blade shank and abutment member.

28. In a propeller, a hub having a spindle thereon, an abutment on the spindle for a

thrust bearing, a blade, a split ferrule adapted to engage the shank of the blade, an adjustable abutment sleeve member adapted to be held inside the ferrule and to cooperate with the first abutment member to inclose a thrust bearing therebetween, a bearing between the sleeve and spindle, and means for holding the ferrule members together on the inclosed blade shank and abutment member.

29. In a propeller, a hub having a spindle thereon, an abutment on the spindle for a thrust bearing, a blade, a split ferrule adapted to engage the shank of the blade, an adjustable abutment sleeve member adapted to be held inside the ferrule and to cooperate with the abutment member on the spindle to inclose a thrust bearing therebetween, a bearing between the sleeve and spindle, means for holding the sleeve members together on the inclosed blade shank and abutment member, and a bearing member on the hub adapted to fulcrum the sleeve member to relieve strains on the spindle due to angular movements of the blade in operation.

30. A propeller comprising a hub, a spindle carried by the hub, an adjustable threaded thrust abutment carried by the spindle, roller bearings carried by the spindle on each side of the abutment, a blade having a hollow shank adapted to extend over and engage the outer roller bearing on the spindle, a multi-part ferrule adapted to detachably engage the outside of the blade shank, and an abutment sleeve member adapted to be engaged by and held inside the inner end of the ferrule, said abutment sleeve member being adapted to inclose the inner roller bearing and to cooperate with the first mentioned abutment on the spindle to form a thrust bearing.

31. A propeller comprising a hub, a spindle carried by the hub, a thrust abutment carried by the spindle, roller bearings carried by the spindle on each side of the abutment, a blade having a hollow shank adapted to extend over and engage the outer roller bearing on the spindle, a split ferrule adapted to detachably engage the outside of the blade shank, an abutment sleeve member adapted to be engaged by and held inside the inner end of the ferrule, said abutment sleeve member being adapted to inclose the inner roller bearing and to cooperate with the first mentioned abutment on the spindle to form a thrust bearing, a fixed abutment on the hub adapted to fulcrum the abutment sleeve member, and means to clamp the ferrule members on the blade shank and abutment sleeve.

32. A propeller comprising a hub, a spindle carried by the hub, a thrust abutment carried by the spindle, roller bearings carried by the spindle on each side of the abutment, a blade having a hollow shank adapted to extend over and engage the outer roller bearing

ing on the spindle, a split ferrule adapted to detachably engage the outside of the blade shank, an abutment sleeve member adapted to be engaged by and held inside the inner end of the ferrule, said abutment sleeve member being adapted to inclose the inner roller bearing and to cooperate with the first mentioned abutment on the spindle to form a thrust bearing, and detachable means for holding the split ferrule in assembled position.

In testimony whereof I affix my signature.

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