July 26, 1932. W. J. BLANCHARD 1,869,182

PROPELLER

Filed Jan. 24, 1929 2 Sheets-Sheet 1

FIG. 1.

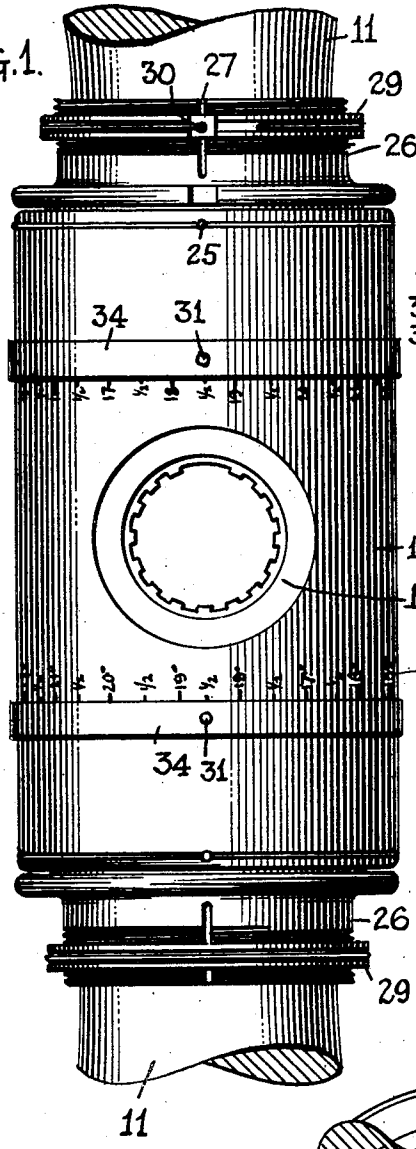


FIG. 2.

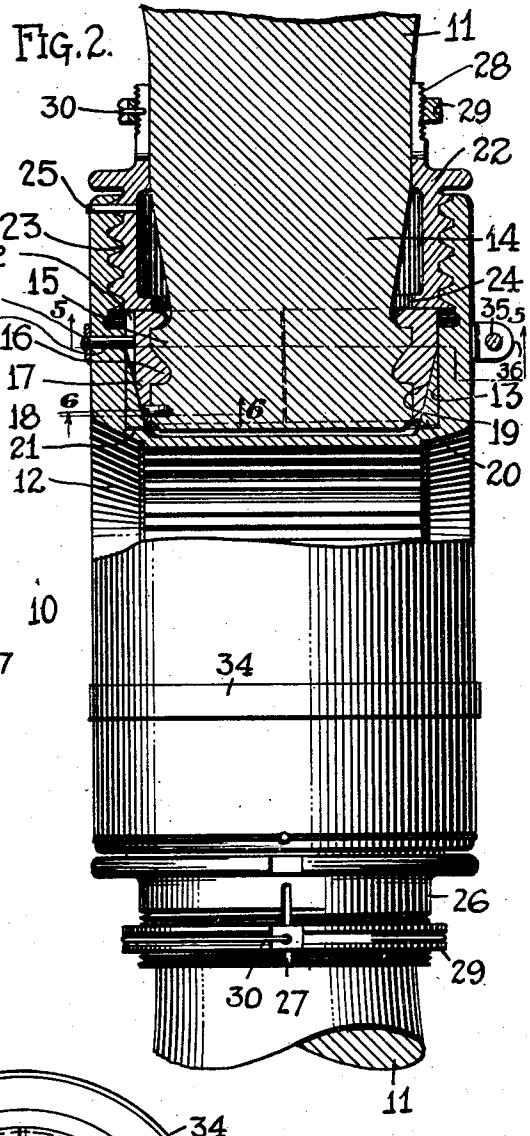
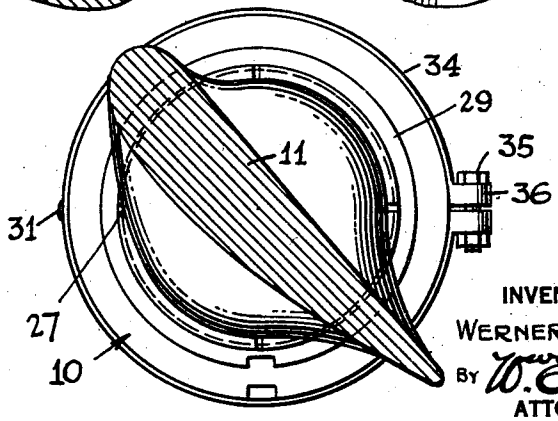


FIG. 3.



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FIG. 4.

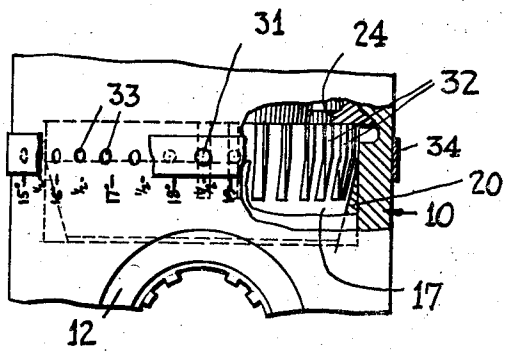


FIG. 5.

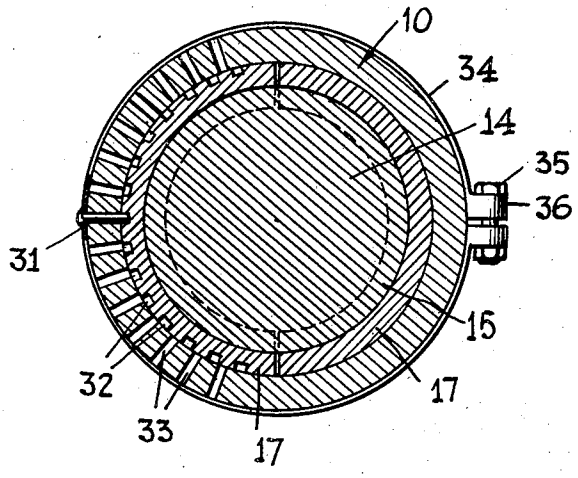


FIG. 6.

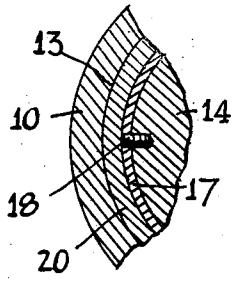
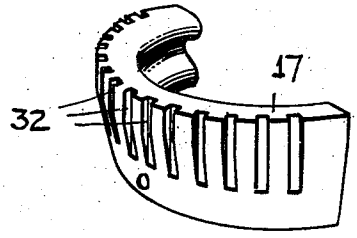


FIG. 7.



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UNITED STATES PATENT OFFICE

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PROPELLER

Application filed January 24, 1929. Serial No. 334,674.

My invention relates to propellers for aircraft and is more particularly concerned with propellers having interchangeable, detachable, and adjustable blades.

In the production of the so-called modern detachable blade aeronautical propellers (especially metal propellers) three objectionable features exist, to wit: (1) unless very careful machine tolerances are used the blades are not held in perfect alignment (2) the clamping means employed to hold the blades at the desired pitch angle setting is unsatisfactory and to a certain extent unreliable where vibrations occur, and (3) the propeller balancing methods employed are both tedious and unsatisfactory in that a slight re-shaping of the blades, or the boring of a hole in the blade stems, or the shifting of the clamps used to hold the hub parts together, or all three operations, are required before perfect balance is achieved.

By the present invention the objectionable features above set forth are completely overcome. A perfect balance may be obtained by the use of one or more varying thickness shims or washers interposed between the inner ends of the blade stems and the inner end walls of the hub or blade receiving sockets. Thru the use of a two-piece or split retaining ring at the inner ends of the blade stems (which rings, along with the blades are securely held by the engagement therewith of the fastening means) all necessity for threads having large radii at the inner blade ends is avoided. Where cracks in the metal stems have heretofore appeared, such cracks have invariably begun, if and when the blade stems are threaded, at the base of one of the sharp edged thread cuts. By means of a novel form of cone seat at the inner blade ends a wedging action having a two-fold purpose is provided. Such wedging action not only holds the inner blade ends in perfect alignment, but it holds also the split retaining rings securely on the blade stems, and centers, at the same time, the propeller blades on or within the hub. Moreover, by means of the use of said split or two-piece retaining ring, propeller blades of standard type, i. e., conforming to present Army and Navy requirements, can be employed without modification.

Other objects and advantages of the invention, such for instance as the use of a vernier arrangement for adjusting the blades to the proper pitch angle setting; the use of an improved type clamping means for securely holding the blade stems against both vibration and rotation; etc., will be hereinafter more fully explained.

In the drawings:

Fig. 1 is a face view of the center or hub section of my improved detachable blade aeronautical propeller;

Fig. 2 is a half elevation and half longitudinal sectional view of the structure illustrated in Fig. 1, said elevation and said section being taken at substantially a right angle to said Fig. 1;

Fig. 3 is an end view of said center or hub portion showing the propeller blade in section;

Fig. 4 is a fragmentary view, partly broken away, showing the vernier arrangement employed;

Fig. 5 is a section on the line 5—5 of Fig. 2;

Fig. 6 is a section on the line 6—6 of Fig. 2, and

Fig. 7 is a perspective view of one of the halves or sections comprising the retaining ring.

In the embodiment of the invention selected for illustration a two blade metal propeller comprising a hub or center portion 10 and opposed detachable, interchangeable, and adjustable blades 11—11 is shown. Where more than two blades are provided such blades should extend radially out from the hub or center portion; 120 degrees apart if three blades are provided, and 90 degrees apart if four blades are provided. Regardless of the number of blades, the hub is preferably a unit or one-piece hub having formed therein a transverse center bore 12, suitably splined, to receive and establish between said hub and the drive shaft (not shown) an appropriate driving connection.

At its opposite ends the hub 10 is provided with opposed blade receiving sockets 13 within which the stems 14 of the opposed blades

11—11 are fitted. Said blades are of circular section throughout the stem length thereof, and have formed therein, at their inner ends, one, two, or more integral annular shoulders 15. These shoulders 15 by their fitting engagement against correspondingly formed shoulders 16 formed on the inner wall of an annular axially split or two-piece retaining ring 17, serve as anchorages for the respective blades. Each ring, tho freely removable upon the withdrawal of the blade stems from fitting engagement in the hub sockets 13, is held against rotation with respect to its associated stem by means of a lock pin 18 (see Fig. 6) binding said parts together.

Propeller blades characterized as above set forth conform to accepted standards. Each, throughout the inner end portion of its length, is of substantially less diameter than the inside diameter of the hub socket 13 within which it is received. Being thus dimensioned, each blade when released, may be bodily withdrawn, without turning, from fitting engagement in its associated socket. That which is true of said blade stems is true also of the retaining rings, except that the latter, in cross-section are of such size and of such shape as to provide, at each inner blade end, a snug or wedge fit by means of which the propeller blades are accurately centered and held, when fastened, rigidly in place. By providing complementary taper bearing surfaces 19 on the inner face of a cone ring 20 and on the outer face of the retaining ring 17 respectively, such wedging action is made possible. To balance the propeller, without re-shaping, lightening, or in any manner altering its form, said cone ring 20, and hence the propeller blade bearing thereon, is made adjustable axially of the hub by the interposition of one or more varying thickness shims or washers 21 between said ring and the inner end wall of the socket.

To lock or fasten the blades to the hub of the propeller, a retaining nut 22 is provided for each blade. Said retaining nut is preferably externally threaded to interlock as at 23 with suitable threads formed on the inner socket wall. At its inner end said retaining nut is enlarged inwardly as at 24 to bear directly and firmly against the outer end of the two-piece retaining ring 17. As said retaining ring 17 and its associated blade stem 14 are firmly interlocked, and insofar as the blade retention is concerned, are in effect, one and the same, such engagement of the retaining nut with said ring is amply sufficient to securely hold said stem rigidly in place and firmly against the cone seat provided at the inner end of the socket. Therefore in the appended claims, the expression "blade stem" is intended to include the stem of a propeller blade having a shoulder formed by an enlarged inner end whether said enlargement is a unitary part of the blade or is a separate part interlocked therewith. As a safety precaution, a lock pin 25 may be provided to hold said nut in its adjusted position.

The means for holding the blades in perfect alignment as well as against vibration and rotation at or with respect to the hub 10, consists of a sleeve-like extension 26 formed integrally upon the outer end of each retaining nut 22. Said extension (see Figs. 1 and 2) is preferably split longitudinally as at 27 and is carried along the stem or shank of the blade for some little distance, the blade, of course, passing therethru. Upon its exterior surface said extension is slightly outwardly tapered and threaded as at 28 to receive thereon or thereover, a suitable clamping nut 29. Said nut, being threaded on the longitudinally split and tapered end of said extension, acts as a clamp, and when tightened down binds the extension against the blade stem, thereby rigidly and firmly holding said blade in place. The clamping arrangements heretofore used have not been tight enough to hold the blade stems against rotative creeping and hence a change in the pitch angle setting of such blades. If desired, a suitable lock means 30 for the nut 22 may be provided.

In addition to the clamps 29, the blades 11—11 are held as to pitch angle setting by means of lock pins 31. Said pins 31, one for each blade, are preferably let thru the hub wall and at their inner ends are adapted to engage in grooves or notches 32 formed in the outer face of one each of the half sections comprising the retaining ring 17. These grooves or notches 32 extend throughout substantially the full depth of the retaining rings, and like orifices 33 formed in the hub wall, and thru which the pins 31 are passed, bear a certain definite relationship to each other. Preferably such orifices and notches are so circumferentially spaced as to provide in effect a vernier scale by means of which an accurate setting of the blades 11—11 may be effected. Once set, the blades are held against rotation in the hub sockets by the lock pins 31 in conjunction with the clamping nuts 29. To prevent the unintentional displacement or removal of each lock pin 31 from its engagement in the selected orifice and groove, each said pin is fastened to a clamping band 34 (preferably spring steel) arranged to encircle the hub. A bolt 35 passing thru lugs 36 formed on the band ends holds said band in place. Moreover, if desired, and as an aid in obtaining the necessary accurate pitch angle setting of the blades 11—11, the hub 10, along the inner edge of each band 34, has indicated thereon suitable scale markings 37. Preferably such markings are indicated in degrees or fractions of degrees.

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 propeller including a hub portion and attached thereto a blade adjustable both axially and rotatably in its relation to said hub, said blade at its inner end having longitudinally extending notches disposed radially about its circumference, means for locking said blade in its axially adjusted position, and means let thru said hub to engage with one or another of said notches to lock said blade in its rotatably adjusted position.

2. A propeller including a hub and attached thereto a blade stem adjustable both axially and rotatably in its relation to said hub, said blade stem at its inner end having formed therein a plurality of longitudinally extending radially disposed notches, means let thru said hub to engage within one or another of said notches to lock said blade stem in its rotatably adjusted position, means for effecting axial adjustment of said blade stem without disrupting its rotatable setting, and means for securing said blade stem rigidly in its finally adjusted position.

3. A propeller including a hub and attached thereto a blade stem adjustable as to pitch setting, said blade stem at its inner end being radially notched, means let thru said hub to engage within said notch to lock said blade stem in its adjusted position, and a removable band encircling said hub and by means of which said lock means is held within said notch.

4. A propeller including a hub portion having formed therein a blade receiving socket, a blade stem fitting at its inner end within said socket, a fastening means interlocking with said hub and bearing at its inner end on said stem for securing said stem within said socket, a longitudinally split sleeve-like extension formed upon the outer end of said fastening means and thru which said stem is carried, said extension being exteriorly threaded throughout a substantial portion of its length, and a nut threaded on said extension to clamp said split end securely against that portion of the blade stem extending outwardly beyond said blade receiving socket.

5. A propeller including a hub portion having formed therein a blade receiving socket, a blade stem fitting at its inner end within said socket, fastening means interlocking with said hub and bearing at its inner end on said stem for securing said stem within said socket, a longitudinally split sleeve-like extension formed upon the outer end of said fastening means and thru which said stem is carried, said extension being exteriorly threaded and slightly longitudinally tapered throughout a substantial portion of its length, and a nut threaded on said tapered extension to clamp said split end securely against that portion of the blade stem extending beyond said blade receiving socket.

6. A propeller including a hub portion having a socket therein, a blade portion having formed on the inner end thereof a plurality of concentric ribs and depressions, an annular retaining element having the inner face thereof shaped to conform to the ribs and depressions of the propeller blade and having the outer face formed with a tapered bearing surface, and means comprising a screw for preventing relative rotative movement between the propeller blade and the retaining element.

7. A propeller including a hub portion having formed therein a blade receiving socket, a blade stem fitting at its inner end within said socket, means for preventing the blade from turning relative to said socket, and means for forcing the blade inward of said socket while it is held against turning.

8. In a variable pitch aeronautical propeller, a hub having a blade receiving socket, a blade secured in said hub socket and rotatable about its own longitudinal axis, an attachment also secured in said socket and cooperating with the inner end of said blade for aiding in positioning it with respect to said hub in said socket, a plurality of equally spaced grooves extending longitudinally of the blade and formed in said attachment, a plurality of equally spaced recesses formed in said hub, the distance between adjacent recesses in said hub being different from the distance between adjacent grooves formed in said attachment, and a locking element inserted partly in a recess in said hub and partly in a groove in said attachment.

9. In a variable pitch aeronautical propeller, a hub having a blade receiving socket, a blade secured in said hub socket and rotatable about its own longitudinal axis, an attachment cooperating with the inner end of said blade for aiding in positioning it with respect to said hub and also positioned in said socket, a plurality of equally spaced grooves formed in said attachment, a plurality of equally spaced recesses formed in the walls of said hub socket, the distance between adjacent recesses in said walls being different from the distance between adjacent recesses formed in said attachment, and a locking element inserted partly in a recess in the walls of the hub socket and partly in a groove in the attachment, said element being positioned with its longitudinal axis substantially perpendicular to the longitudinal axis of the blade and passing substantially perpendicularly through the wall of the hub and into the groove within the concentric propeller blade.

10. A propeller including a hub portion having formed therein a blade receiving socket, a blade stem having its inner end inserted within said socket, a cone-shaped ring inserted within the said socket between the said blade and the socket, means for holding the blade against rotation about its longitudinal axis, and means for forcing the blade inward against the said cone shaped ring to center the said blade by the wedging action of the ring while the blade is maintained against rotative movement about its longitudinal axis.

11. A propeller including a hub portion having formed therein a blade receiving socket, a blade fitting at its inner end within said socket and having said inner end formed with a series of alternate annular grooves and ribs, said ribs each having an outward bearing surface thereof substantially perpendicular to the longitudinal axis of the propeller blade, and means interlocking with said hub and bearing on said bearing surface for securing said blade to said hub.

12. A propeller including a hub portion provided with a blade receiving socket formed with substantially parallel sides, a blade fitting at its inner end within said socket, a two-piece retaining ring comprising semi-cylindrical halves interlocking the inner end of said blade, a removable ring seated within and shaped to provide at the inner end of said socket a taper bearing surface against which said retaining ring is adapted to bear to center said blade within said socket, and means interlocking with said hub and bearing on said retaining ring for securing said blade to said hub.

13. A propeller including a hub portion having formed therein a blade receiving socket, a blade, an axially split retaining ring interlocking with and encircling the inner end of said blade and provided at its own inner end with an annular bearing surface, a bearing surface within said socket adjustable axially in its relation to said blade to regulate the depth to which said blade is insertable within said socket, means interlocking with said hub and bearing on said retaining ring for securing said blade in said hub, and means for forcing said blade inwardly and securing it rigidly in its adjusted position.

14. A propeller including a hub portion having formed therein a blade receiving socket, a blade furnished with a blade stem provided at its inner end with a taper bearing surface, an axially adjustable taper bearing surface against which said first mentioned taper bearing surface is adapted to bear in the finally adjusted position of said blade, said last mentioned taper bearing surface being disposed at or near the inner end of said blade receiving socket, substantially non-elastic means inward of said bearing surface for holding it in adjusted position, and means for securing said blade rigidly in its adjusted position.

15. A propeller including a hub portion having formed therein a blade receiving socket, a blade furnished with a blade stem provided at its inner end with a taper bearing surface, an axially adjustable taper bearing surface against which said first mentioned taper bearing surface is adapted to bear in the finally adjusted position of said blade, said last mentioned taper bearing surface being disposed at or near the inner end of said blade receiving socket, a shim inward of said bearing surface for holding it in an adjusted position, and means for securing said blade rigidly in its adjusted position.

16. A propeller including a hub portion having formed therein a blade receiving socket, a blade fitting at its inner end within said socket, said blade at said inner end having an over-all diameter substantially less than the inside diameter of said socket to admit of the bodily axial adjustment and removal of said blade within and from said socket, a two-piece retaining ring interlocking with and encircling the inner end of said blade, said retaining ring having formed thereon a bearing surface, a substantially complemental bearing surface against which said first mentioned bearing surface is adapted to bear in the finally adjusted position of said blade, said last mentioned bearing surface being axially adjustable in its relation to said blade by the interposition between it and the inner end of said socket of one or more removable shims, and means interlocking with said hub and bearing on said retaining ring for securing said blade rigidly in its adjusted position.

17. A propeller including a hub portion and attached thereto a blade adjustable as to pitch setting, said blade at its inner end being provided with a radially notched blade stem and said hub having formed therein a radially extending orifice which, according to the pitch setting desired, is adapted to coincide with one or another of said notches, and means extending from said orifice and into said coinciding notch to lock said blade in its adjusted position.

18. A propeller including a hub portion and attached thereto a blade adjustable as to pitch setting, a radially notched ring encircling the inner end of said blade, means for preventing the rotation of said ring relative to said blade, said hub having formed therein a radially extending orifice which, according to the pitch setting desired, is adapted to coincide with one or another of the notches in the ring, and means extending through said orifice and into said coinciding notch to lock said blade in its adjusted position.

19. A propeller including a hub portion and attached thereto a blade adjustable as

to pitch setting, said blade at its inner end being provided with a blade stem having formed therein a notch and said hub having formed therein a plurality of radially disposed orifices which, according to the pitch setting desired, may be brought into coincidence, one at a time with said notch, and means insertable through the coinciding orifice to engage within said notch to lock said blade in its adjusted position.

20. A propeller including a hub portion and attached thereto a blade adjustable as to its pitch setting, a sleeve encircling said blade, means for preventing relative rotation between said blade and said sleeve, said sleeve having formed therein a notch and said hub having formed therein a plurality of radially disposed orifices which, according to the pitch setting desired, may be brought into coincidence, one at a time with said notch, and means insertable through the corresponding orifice to engage within said notch to lock said blade in its adjusted position.

21. A propeller including a hub portion and attached thereto a blade adjustable as to pitch setting, a radially notched ring mounted upon the inner blade end, the notches of said ring being spaced at predetermined circumferentially separated intervals of spaces, and said hub having formed therein a plurality of orifices likewise circumferentially separated at predetermined intervals of space, the intervals of space in each instance being so proportioned as to provide an effective vernier scale, and means insertable within the orifice and notch which at the time coincide to lock said blade in its adjusted position.

22. A propeller including a hub portion and attached thereto a blade adjustable both axially and rotatably in its relation to said hub, a ring mounted upon the inner end of said blade having at its own inner end longitudinally extending notches disposed radially about its circumference, means for locking said blade in its axially adjusted position and means let through said hub to engage with one or another of said notches to lock said blade in its rotatably adjusted position.

23. A propeller including a hub and attached thereto a blade adjustable both axially and rotatably in relation to its hub, a ring mounted upon the inner end of said blade having at its own inner end formed therein a plurality of longitudinally extending radially disposed notches, means let through said hub to engage within one or another of said notches to lock said blade in its rotatably adjusted position, means for effecting axial adjustment of said blade without disrupting its rotatable setting, and means for securing said blade rigidly in its finally adjusted position.

24. A propeller including a hub and attached thereto a blade adjustable as to pitch setting, a ring mounted upon the inner end of said blade and being at its own inner end radially notched, means let through said hub to engage within said notch to lock said blade in its adjusted position, and a removable band encircling said hub and by means of which said locking means is held within said notch.

25. A propeller including a hub portion having formed therein a blade receiving socket, a blade fitting at its inner end within said socket, a ring mounted upon the inner end of said blade, a fastening means interlocking with said hub and bearing at its inner end on said ring for securing said blade within said socket, a longitudinally split sleeve-like extension formed upon the outer end of said fastening means and through which said blade is carried, said extension being exteriorly threaded throughout a substantial portion of its length, and a nut threaded on said extension to clamp said split ends securely against that portion of the blade extending outwardly beyond said blade receiving socket.

26. A propeller including a hub portion having formed therein a blade receiving socket, a blade fitting at its inner end within said socket, a ring mounted upon the inner end of said blade, a fastening means interlocking with said hub and bearing at its inner end on said ring for securing said blade within said socket, a longitudinally split, sleeve-like extension formed upon the outer end of said fastening means, and through which said blade is carried, said extension being exteriorly threaded throughout a substantial portion of its length, and a nut threaded on said extension to clamp said split end securely against that portion of the blade extending outwardly beyond said blade receiving socket.

27. A propeller including a hub portion and attached thereto a blade adjustable as to pitch setting, a ring mounted upon the inner blade end and having a series of circumferentially spaced apart notches thereon, means for preventing rotation of said ring upon said blade, and means let through said hub to engage within a selected notch to lock said blade in its angularly adjusted position, said notches being so disposed that a selected notch will be in registry with said last mentioned means regardless of the position of said ring along the axis of said hub.

28. A propeller including a hub portion having formed therein a blade receiving socket, a blade furnished with a blade stem provided at its inner end with a taper bearing surface, an axially adjustable taper bearing surface against which said first mentioned taper bearing surface is adapted to bear in the finally adjusted position of said blade, said last mentioned taper bearing surface being disposed at or near the inner end

of said blade receiving socket, means disposed inward of said last mentioned bearing surface for holding it in its longitudinally adjusted position, and means for securing said blade rigidly in its adjusted position.

In testimony whereof I hereunto affix my signature.

WERNER J. BLANCHARD.