May 4, 1926. 1,582,978

A. GRILLI

PROPELLER

Filed March 29, 1924

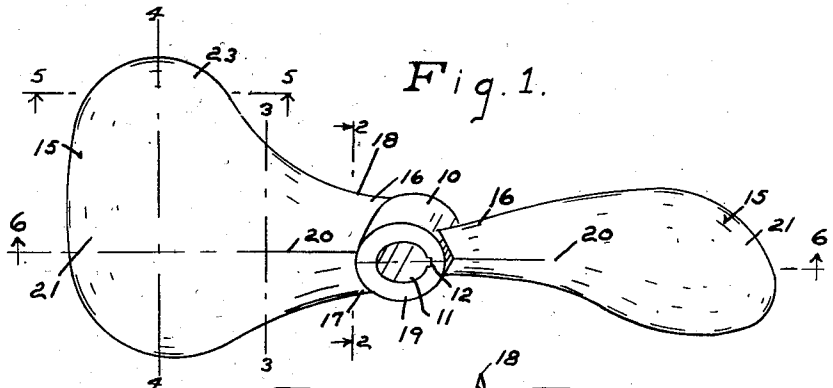


Fig. 1.

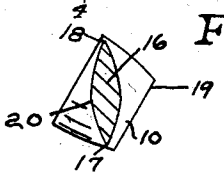


Fig. 2.

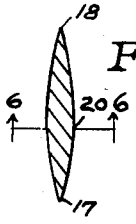


Fig. 3.

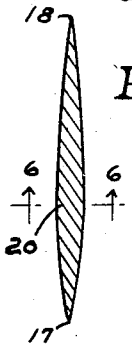


Fig. 4.

Fig. 5.

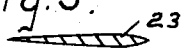
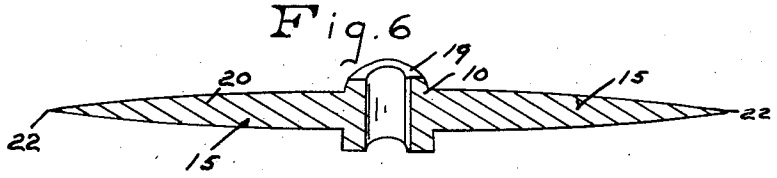


Fig. 6



INVENTOR.
Angelo Grilli
BY
Erwin, Wheeler & Woodard
ATTORNEYS.

Patented May 4, 1926. 1,582,978

UNITED STATES PATENT OFFICE.

ANGELO GRILLI, OF MILWAUKEE, WISCONSIN.

PROPELLER.

Application filed March 29, 1924. Serial No. 702,761.

To all whom it may concern:

Be it known that I, ANGELO GRILLI, a subject of the King of Italy, residing at Milwaukee, county of Milwaukee, and State of Wisconsin, have invented new and useful Improvements in Propellers, of which the following is a specification.

This invention relates to improvements in propellers.

It is the object of this invention to provide a novel and improved propeller design wherein the parts will be arranged symmetrically about a substantially straight transverse line normal to the hub, said line representing the portions of greatest thickness of each blade for strength, and the blade being formed with greatly increased chord at effective radii from the hub and nevertheless being so designed that at all radial distances from the hub the said line or portion of greatest thickness of the blade will lie at proper and substantially constant proportional distances from the leading and trailing edges of each blade.

It is well known that for any propeller, whether it be intended for service in gases or liquids, the greatest thickness of the blade must, for proper stream lining effect, be located at determinable points intermediate the leading and trailing edges of the blade. In general terms, the proper position for the points of greatest thickness in an aerofoil has been defined as approximately two-fifths of the entire chord of the aerofoil, measured from the leading in the direction of the trailing edge. In that position not only is a proper stream line effect achieved, but also the portion of greatest thickness (and consequently of greatest strength) coincides approximately with the center of thrust of the aerofoil. The same is true of propellers which are to be used in liquids, such for example, as ship propellers. It will be understood, of course, that these statements are intended only in the most general way, and that I do not desire to limit myself to any specific position for the thickest portion of the blade since I appreciate that in varying types of propellers the requirements in this regard may vary widely.

Various attempts have been made to design propellers having increased chord at points remote from their hubs. The obvious function of the increased chord of a propeller blade is to increase its effective surface, and the portions of the blade which have the greatest opportunity for interaction with a fluid in which the blade is operated are those portions which are remote from the hub. Nevertheless, in spite of the various attempts which have heretofore been made to enlarge the chords of propeller blades remote from their hubs, there has not, so far as I am aware, been any propeller heretofore designed to provide an enlarged chord remote from its hub while maintaining its leading and trailing edges substantially at uniformly proportionate distances upon either side of a straight line constituting the projected diameter of the hub. Such a design has great advantages in the way of combined efficiency and strength, and it is my purpose to produce a novel and improved design affording greater effectiveness and strength than have heretofore been possible.

In the drawings:

Figure 1 is a perspective view of an embodiment of my improved propeller.

Figure 2 is a section taken on line 2—2 of Figure 1.

Figure 3 is a section taken on line 3—3 of Figure 1.

Figure 4 is a section taken on line 4—4 of Figure 1.

Figure 5 is a section taken on line 5—5 of Figure 1.

Figure 6 is a section taken on line 6—6 of Figures 1 to 4, inclusive.

Like parts are identified by the same reference characters throughout the several views.

The particular propeller herein illustrated is one which has been designed for use for boat propulsion, but the principles hereinafter to be disclosed are such that those skilled in the art can readily apply them to all forms of propellers.

The propeller hub is indicated at 10, and it has a central bore 11 adapted to receive a shaft. A keyway is provided at 12 to facilitate fastening the propeller rigidly to the shaft for rotation therewith.

The propeller is organized with particular reference to a selected diameter of the hub which will hereinafter be considered to be projected along the line indicated at 6—6 in Figure 1. The blades 15 extend along this line, and my reason for indicating section 6—6 upon each of Figures 1 to 4, inclusive, arises in my desire to point out the fact that at all of the different sections

indicated the thickest portion of the blade is invariably substantially coincident with the projected diameter of the propeller which extends along the line 6—6 in Figure 1.

The root portions 16 of the blades are relatively heavy. Their chord, as measured by drawing a line between the leading edge 17, and the trailing edge 18 is relatively short and corresponds in general to the diagonal of the hub, as is best shown in Figure 2. It will be noted also that, in conformity with the usual propeller practice, the pitch of the root section of the blade is high. It will be noted, however, that the chord of the root section does not exactly correspond with the diagonal of the hub since its portion of greatest thickness lies symmetrically with reference to a line which is not only a diameter of the hub but is also intermediate the ends of the hub upon its axis, and since, as will be pointed out hereinafter, the point of greatest thickness of every portion of the blade is nearer to its leading than to its trailing edge, the leading edge 17 of the root portion of the blades does not extend to the forward margin 19 of the hub.

Although, for marine use, the propeller herein indicated will almost invariably be constructed integrally, it is nevertheless a fact that its portion of greatest thickness, extending as it does upon the projected diameter of an axially central part of the hub, constitutes in effect a spar in each blade. It is only effective as a spar in so far as it extends upon substantially straight lines. The inability of a spar or structural member to withstand such torsional strains as are produced incident to its subjection to lateral pressures directed to points remote from its axial center are well known. It will be apparent, therefore, that the advantages of constructing the propeller blade to provide a perfectly straight spar portion will be clear. For the purposes of this description the portion of greatest thickness extending radially through each of the blades from the hub, and indicated in the drawings at 20, will hereinafter be designated as the spar portion.

Not only is the spar portion 20 of each blade preferably perfectly straight, but also the blade is so designed that its center of pressure at all points will coincide substantially with the axis of its spar portion. As has already been pointed out, such a construction may be made to harmonize well with a proper stream lining to enable the blades to pass readily through a fluid in which the propeller is operated.

The really effective outer portion 21 of each blade has a chord which is greatly elongated. The elongation takes place rather abruptly beyond the line indicated at 3—3 in Figure 1. The elongated chord provides a great area adapted to act upon a fluid for the consequent development of thrust. I secure the desired increase in area by extending the chord of the blade in a substantially constant relative proportion upon either side of the axial center line or strut portion 20. In other words, if such center line be located at two-fifths of the length of the chord rearwardly from the leading edge this relative location will be preserved, generally speaking, irrespective of the total length of the chord. Thus, when the trailing edge 18 of the blade is turned at section line 3—3 to extend rearwardly, the leading edge 17 is likewise turned to extend in a proportion of the lesser degree forwardly. No attempt has been made to make this proportion exact and definite in the intermediate portions of the blade, since by so doing the leading edge, which must necessarily be the strongest part of the blade, would become so irregular as to be weakened. Accordingly, the curve of the leading edge is slightly more gradual than would result from a strict adherence to the general rule above stated. Nevertheless, the stated proportion of the chord dimensions upon either side of the spar portion is followed as closely as is consistent with regard for blade strength and stream lining.

Figure 6 is, in effect, a section through the hub and spar portions of both blades. It will be noted that this spar portion tapers toward its extremity until at the tips 22 the forward and rearward blade surfaces meet. At the same time, the blade has very material thickness throughout all those portions of the spar section where great strength is necessary. The portion 23 of the trailing part of the blade corresponds quite closely in its proportionate contour to the spar section shown in Figure 6. A comparison of these two sections, however, demonstrates the fact that the general rules or principles stated for the proportion of the propeller blade are not followed so closely as to result in sharp angles or general loss of stream line from a loss of strength such as would ensue if any given portion of the blade were projected too sharply beyond adjacent portions thereof.

I claim:

1. In a device of the character described, a member designed for interaction with a fluid and having a substantially straight spar section comprising its portion of greatest thickness, said member having leading and trailing edges at varying distances apart, the chord distance from said spar section to the leading edge being in approximately constant ratio to the chord distance from said spar section to said trailing edge.

2. In a device of the character described, a member adapted for interaction with a fluid, said member having a substantially

straight spar section comprising a portion of greatest thickness and having non-parallel leading and trailing edges, the trailing edge being farther distant from said chord section than the leading edge, and the chord distance from said spar section to the leading edge bearing an approximately constant ratio to the chord distance between said spar section and the trailing edge.

3. A propeller, including a blade having a substantially radial spar section comprising the portions of greatest thickness, said blade tapering forwardly and rearwardly from said spar section to leading and trailing edges, respectively, and being so formed that its center of pressure in rotatively traversing a fluid medium will substantially coincide throughout its length with said spar section.

4. A propeller, including a blade having a substantially radial spar section comprising its portion of greatest thickness and tapering forwardly and rearwardly from said section to leading and trailing edges, respectively, said edges being non-parallel, and the distance of said leading edge from said spar section bearing a substantially constant ratio to the distance of said trailing edge from said spar section throughout the length of said blade, and said ratio being so determined that the center of pressure on said blade, when said blade traverses a fluid medium in the course of operation of said propeller, will substantially coincide with said spar section.

5. In a propeller, a blade having a substantially linear spar section comprising its portion of greatest thickness, said spar section tapering in thickness toward the tip of said blade, and operating surfaces converging forwardly and rearwardly from said spar section to leading and trailing edges, respectively, the chord distance from each given point on said spar section to the leading edge bearing a substantially constant ratio to the chord distance from said point to the trailing edge, with the latter chord distance being the greater, and said surfaces being extended at a point adjacent the tip of said blade to provide a relatively very great total chord while substantially maintaining the ratio aforesaid.

6. A propeller, including a hub and a pair of blades projecting symmetrically therefrom, said blades having root portions of relatively short chord and portions adjacent their tips of relatively great chord, each of said blades including a spar section upon a projected common diameter of said hub and said spar section comprising in each blade substantially the thickest portion of each blade, and each blade having operating surfaces extending convergingly forwardly and rearwardly for shorter and longer chord distances to leading and trailing edges, respectively, the former chord distances bearing an approximately constant ratio to the latter chord distances at substantially every point of each blade, and said ratio being selected with reference to the medium in which said propeller is operable and the pitch and speed thereof, whereby the center of pressure on said blades will approximately coincide with their respective spar sections.

ANGELO GRILLI.