

May 26, 1925.

1,539,273

S. A. REED

PROPELLER

Original Filed May 26, 1920

Fig. 1,

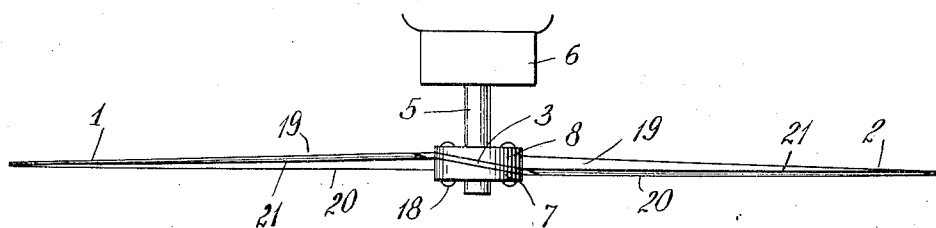


Fig. 2,

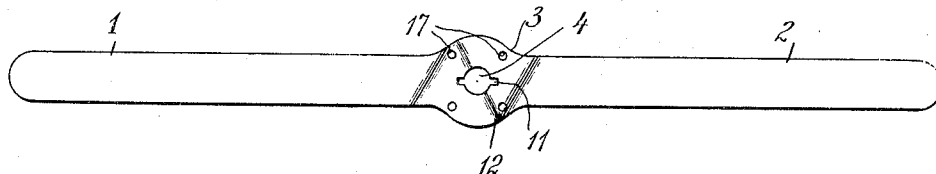
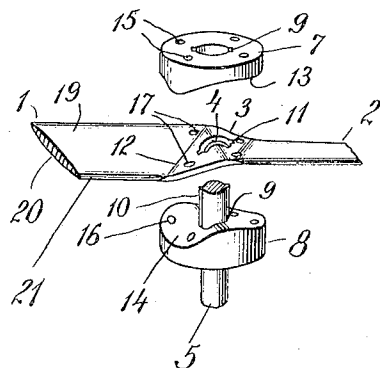


Fig. 3,



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Patented May 26, 1925.

1,539,273

UNITED STATES PATENT OFFICE.

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PROPELLER.

Original application filed May 26, 1920, Serial No. 384,293. Divided and this application filed June 26, 1923. Serial No. 647,897.

To all whom it may concern:

Be it known that I, SYLVANUS A. REED, a citizen of the United States, residing in New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Propellers, of which the following is a specification.

This application is a divisional one of my application for aeronautical propellers, filed May 26th, 1920, Serial No. 384,293, patented July 31, 1923, No. 1,463,556.

My invention relates to propellers for air craft and flying machines and discloses a novel principle for obtaining the necessary rigidity of the propeller blades to resist the stresses, thereby making possible the use of much thinner blades than heretofore with a gain in efficiency.

Heretofore aeronautical propellers have been made of material such as wood or metal constructed to be structurally rigid against operative stresses, such rigidity usually being substantially sufficient, even when at rest, to resist tangential, axial and radial stresses which would occur in full speed operation. It is obvious that when an aeronautical propeller is operated, centrifugal force adds to the structural rigidity due to the form of the propeller, a quasi or virtual or dynamic rigidity from the radial tension due to centrifugal force, and this added rigidity is a contingent advantage, but hitherto not regarded as an element which would justify omitting any considerable percentage of the elements providing static or intrinsic rigidity. I have ascertained by many experiments, and as can be easily calculated from well known laws of mechanics, that at certain rotative speeds, a stage or condition is reached where structural or intrinsic rigidity can be largely and to a substantial extent discarded in the design of the propeller and its construction, and reliance placed mainly upon the quasi or virtual rigidity of kinetic character due to centrifugal force.

My invention consists in the various novel and peculiar constructions and arrangements of parts as herein set forth and particularly pointed out in the claims, and I have illustrated a type of my invention in the accompanying drawings which are somewhat diagrammatic in parts, and wherein I endeavor to clearly show the rela-

tively thin character of the propeller blades the cross-section of which may be varied.

In the said drawings:

Fig. 1 is a side view of an aeronautical propeller embodying my invention and secured to a hub mounted on a drive-shaft which is connected with a suitable source of power indicated in said figure, the propeller being a double-bladed one and the view being taken edgewise thereof.

Fig. 2 is a broadside view of the propeller shown in Fig. 1, and shown as detached.

Fig. 3 is an enlarged perspective view of the central part of the two-bladed propeller with the outer portion of the blades broken away, together with two clamping sections of the hub shown as spaced apart in relative clamping positions ready to be assembled.

Referring to the drawings, in which like numerals of reference designate like parts throughout, 1 and 2 are propeller blades here shown as made integral, that is to say, the whole propeller is a single piece, though it may be otherwise, with a central connecting or hub part 3, and the blades extend in line with each other in diametrically opposite directions. The hub part 3, is provided with a central orifice 4, for receiving the drive-shaft 5, driven by a suitable source of power indicated at 6, such as an internal combustion engine, or steam engine or other well known form of motor.

The propeller just described contains its own hub 3, and may be used without additional hub structure, but it may be attached to the usual tubular metal hub member customarily employed with wooden propellers and the same mounted on the propeller shaft. I prefer, however, to provide the propeller hub 3, with additional sectional members made in two clamping sections 7 and 8, each having a central opening for the shaft 5, and each formed with keyways 9, for receiving the key 10, fixed on the shaft, the central part 3, of the propeller being also formed with key-ways 11, for receiving the shaft key 10, thereby strengthening the assembled parts.

In order to give the blades 1 and 2, the necessary pitch-angle, I bend or twist the central connecting part 3, as indicated at 12, in a manner suitable to provide such pitch-angle at the outer part of the blade.

Thus a simple twist would accomplish the same result, but in order to avoid possible unequal strain on the material involved by twisting metal cold, I prefer to use the bend 12, which is shown as a geometrical double bend of such shape and character as to provide each blade with the same pitch-angle, and obviously the shape or form of said bend may be varied as desired, so long as the necessary pitch-angle is obtained, as indicated in the drawings.

It will also be noted that each blade has its pitch or blade angles diminishing helically or screw-like from root to tip, as indicated in Fig. 1, which shows an edge view in elevation of my propeller, the said construction giving the effect in said view of a convergence from root to tip of the edges of the blade, which Fig. 2, shows of substantially uniform width.

The clamping-faces 13 and 14, of the respective hub sections 7 and 8, are shaped to conform to and to truly fit the pitch-angle bend 12, upon the opposite sides of the central part 3, and they are counter parts of each other. The hub sections are provided with bolt-holes 15 and 16, respectively, which register with a similar set of holes 17, in the hub part 3, and receive the bolts 18, by means of which the said parts are securely fastened together, as indicated in Fig. 1. Thus the hub members serve to hold and assist in retaining in shape the one-piece double-bladed propeller and the blades external to the hub are maintained at the desired pitch-angle.

The blades taper in thickness from hub to tip, as indicated in the drawings, and the rear side is somewhat flat as at 19, while the forward face is slightly bowed or curved as at 20, while the edges are relatively sharp, as indicated at 21, but of course this form may be varied as found expedient.

My improved propeller may be made from suitable sheet metal, or by forging or casting the same, and it can be manufactured at a lower cost than other forms of aeronautical propellers. It can be rapidly and cheaply made by stamping it directly from sheet-metal in completed form except for minor finishing.

It will be observed that while for the purposes of illustration, I have herein set forth specific embodiments of my invention for utilizing a high degree of radial tension due to centrifugal force as means for creating and maintaining sufficient virtual rigidity in thin propeller blades to make them practically operative, I am aware that many changes and modifications may be made in the different features thereof, without, however, departing from the spirit of my invention.

The term relatively thin as used herein, is intended to define a body whose maximum

thickness is that of a metal plate as distinguished from the thinness of a metal sheet, on the one hand, and the thickness of a metal bar or like bulky body, on the other.

It is to be noted that the flexing stresses of operation are slight at slow rotative speeds, as while getting up speed, the centrifugal force being also slight, but the degree of flexibility of my blades at various points is so proportioned that at every speed the centrifugal force supplements the intrinsic rigidity sufficiently for the necessary actual rigidity to meet the stresses at that speed.

While I have herein described my invention as particularly applicable for use in connection with aeronautics, it is obvious that the same is applicable for use in any field in which air propulsion or blasts can be used.

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

1. In propelling means, a hub and a propeller attached thereto bent or twisted in one general angular direction in its entirety in the region of connection with said hub to maximum pitch-angles, and beyond said region twisted in the reverse direction to provide pitch-angles diminishing helically towards and to the tips.

2. A one-piece propeller bent or twisted in its entirety in one general angular direction in the axial region so as to bodily distort each blade to a maximum pitch-angle and twisted beyond said region in the reverse direction so as to provide said blades with pitch-angles diminishing helically towards and to the tips of the blades.

3. A propeller made in one piece of metal whose blades have their pitch-angles made by bending and twisting the metal across the entire width to a permanent set at angles at different sections diminishing helically from roots to tips.

4. A propeller made in one-piece of metal whose blades have their pitch-angles made by bending or twisting the metal across the entire width of the blades to a permanent set at angles at different sections diminishing helically from roots to tips and with blade edges relatively sharp.

5. A one-piece propeller made of metal and whose blades have a helical pitch varying progressively from a maximum angle near the driving-shaft to a minimum angle at the tips, the central part of the propeller being distorted in one direction to establish said maximum angles, and said blades being distorted in the opposite direction to establish said progressive reduction in angles towards the tips.

6. A metal aeronautical propeller having blades with a relatively wide axial region transversely distorted in one angular direc-

tion to provide maximum pitch-angles at the blade roots and the blades beyond said region twisted in the reverse angular direction to provide pitch-angles diminishing helically to the tips, one face of said blades being of convex cross-section with sharp edges.

7. A metal aeronautical propeller made from wrought metal and having blades with a relatively wide axial region transversely distorted in one angular direction to provide maximum pitch-angles at the blade roots and the blades beyond said region twisted in the reverse angular direction to provide pitch-angles diminishing helically to the tips.

8. A metal aeronautical propeller made from flat metal and having blades with a relatively wide axial region transversely distorted in one angular direction to provide maximum pitch-angles at the blade roots and the blades beyond said region twisted in the reverse angular direction to provide pitch-angles diminishing helically to the tips.

9. An aeronautical propeller having blades with a relatively wide axial region transversely distorted in one angular direction to provide maximum pitch-angles at the blade roots and the blades beyond said region being twisted in the reverse angular direction to provide pitch-angles diminishing helically to the tips, and a sectional hub shaped to such a fit to the propeller central surfaces as to assist in maintaining the central distortion thereof.

10. An aeronautical propeller formed of metal and having blades with a relatively wide axial region transversely distorted in one angular direction to provide maximum pitch-angles at the blade roots and the blades beyond said region being twisted in the reverse angular direction to provide pitch-

angles diminishing helically to the tips, and a hub shaped to such a fit therewith as to effectively transmit torque.

11. A one-piece aeronautical propeller whose angle reversal in the central region is effected by bends or twists therein crossing the axis, in combination with blocks shaped each with one face conforming to said bends or twists and the opposite face substantially parallel with the radial plane, said blocks being constructed and arranged for attachment to the drive-shaft.

12. A metal aeronautical propeller with a relatively wide axial region transversely distorted in one angular direction to provide maximum pitch-angles at the blade roots and the blades beyond said region twisted in the reverse angular direction to provide pitch-angles diminishing helically to the tips.

13. A solid non-hollow metal aeronautical propeller with a relatively wide axial region transversely distorted in one angular direction to provide maximum pitch-angles at the blade roots and the blades beyond said region twisted in the reverse angular direction to provide pitch-angles diminishing helically to the tips.

14. A metal aeronautical propeller with a relatively wide axial region formed with a central shaft-receiving perforation and said axial region being transversely distorted in one angular direction to provide maximum pitch-angles at the blade roots and the blades beyond said region twisted in the reverse angular direction to provide pitch-angles diminishing helically to the tips.

In testimony whereof, I have hereunto set my hand.

SYLVANUS A. REED.