L. T. FREDERICK.

VARIABLE PITCH PROPELLER.

APPLICATION FILED DEC. 30, 1918.

1,365,314. Patented Jan. 11, 1921.

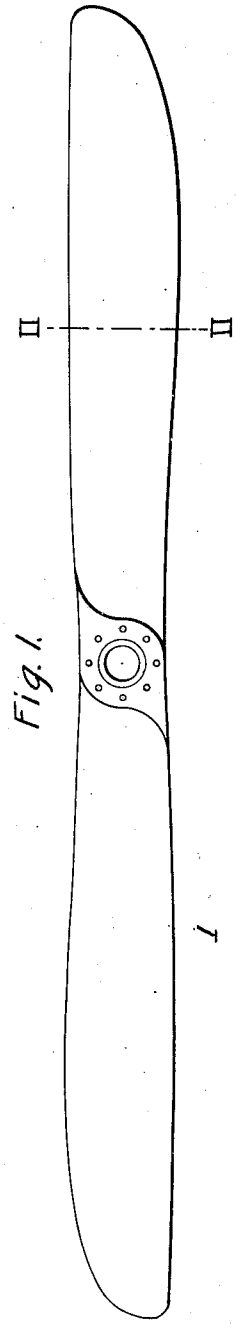


Fig. 1.

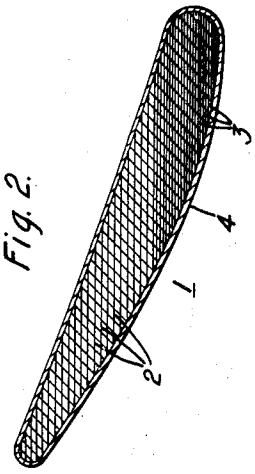


Fig. 2.

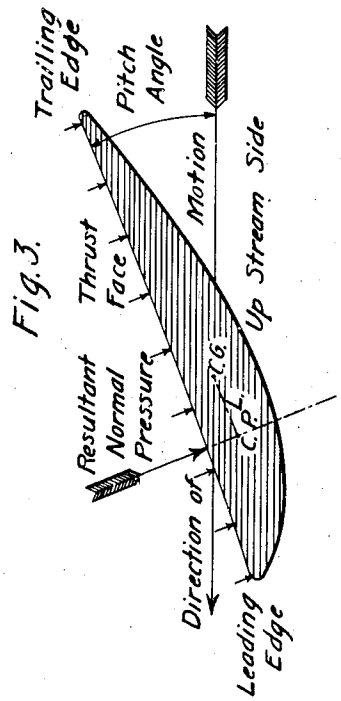


Fig. 3.

WITNESSES:

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VARIABLE-PITCH PROPELLER.

1,365,314. Specification of Letters Patent. Patented Jan. 11, 1921.

Application filed December 30, 1918. Serial No. 268,956.

To all whom it may concern:

Be it known that I, LOUIS T. FREDERICK, a citizen of the United States, and a resident of Wilkinsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Variable-Pitch Propellers, of which the following is a specification.

My invention relates to propellers and more particularly to composite propellers comprising superimposed layers of fibrous material impregnated with a hardened binder, and it has, for its primary object, the provision of a variable pitch propeller of that type.

Propellers now in use are of a non-variable pitch type and, as a result, they cause airplane engines driving them to run at different speeds, depending upon the blade thrusts under varying circumstances. For example, with a certain propeller of non-variable pitch type and an engine driving it with the throttle wide open, the engine attained a speed of 1410 R. P. M. while the plane, upon which the engine and propeller were mounted, was blocked to the ground. During "climb," the engine speed increased to 1450 R. P. M. and, in horizontal flight, ran at 1500 R. P. M.

These undesirable changes in engine speed are caused by changes of torque imposed chiefly by the changes of the propeller pitch which, in turn, are caused partly by the flexibility or resiliency of the material of which the propeller is made and partly because of certain necessary inherent requirements of design.

More particularly, the object of my invention resides in overcoming, to a great extent, at least, changes in propeller pitch, caused by flexibility of the propeller material, by stiffening certain portions of the propeller relative to the remaining portions.

A still further object of my invention consists in accomplishing the stiffening or reinforcing of certain portions of the propeller without the addition of further material or of metallic stiffening elements or the like, which would add to the weight of the finished propeller.

With these and other objects in view, my invention will be more fully described, illustrated in the drawings, in the several views of which corresponding numerals indicate like parts, and then particularly pointed out in the claims.

Figure 1 is a front elevation of a propeller constructed in accordance with my invention; Fig. 2 is a transverse, sectional view taken through one of the propeller blades at substantially the line II—II of Fig. 1 and Fig. 3 is a diagrammatic sectional view explanatory of the principle upon which my invention is founded.

In a copending application filed by D. A. Dickey, on Dec. 30, 1918, bearing Serial Number 268,949 and assigned to the Westinghouse Electric & Manufacturing Company, is disclosed a propeller of composite type comprising a plurality of superimposed layers of fibrous sheet material, such as duck, impregnated with a suitable hardened binder, such as a phenolic condensation product.

As there set forth, a propeller may be formed by cutting the several layers or laminations, to the proper shapes and sizes, from a sheet of the impregnated duck, superimposing the layers thus formed in proper relative positions, dependent upon their shapes and sizes, and curing the propeller body thus assembled by subjecting it to heat and pressure, in a suitably shaped mold, to compact the material and transform the binder to its hard and substantially insoluble and infusible condition.

In practising my invention, I may construct a propeller by following the method disclosed in the above mentioned application, superimposing the several layers of the impregnated sheet material employed in the manner there set forth, with the layers disposed in planes substantially parallel to the faces of the propeller hub. My invention, however, resides in the provision of means for stiffening the leading edges of the blades, relative to the remaining portions of the blades, whereby I produce a variable-pitch propeller.

To accomplish this, I may employ two or more different kinds of fibrous sheet material, impregnated with a suitable binder, such as a phenolic condensation product, the materials employed being such as to possess

different degrees of resiliency and locate the stiffer material in the leading edge portions of the blades of the propeller.

For example, referring more particularly to Figs. 1 and 2 of the drawings, I have disclosed a propeller 1, the main body portion of which may consist of superimposed layers 2 of duck, or equivalent material, impregnated with a hardened phenolic condensation product and the leading edge portions or which may comprise correspondingly superimposed layers of another fibrous sheet material 3, such as paper, of proper character, impregnated with the same hardened binder. This propeller may, if desired, be provided with an outer covering 4, of either duck or paper or other suitable material, which may be preferably impregnated with the same binder as the body of the propeller and molded with the rest of the propeller. Such a covering is not in any way, essential, however, and, if employed, is provided chiefly to give the finished propeller a uniform and neat appearance.

A propeller constructed in accordance with my invention, with leading edge portions of paper and trailing edge and body portions of duct, all impregnated with a hardened binder, is variable in pitch and far superior to the propellers now in use because of the stiffening of the leading edges of the blades caused by the localization of the stiffer paper material therein.

For a clearer understanding of the principle upon which my invention is founded, attention is directed to Fig. 3 of the drawing which shows diagrammatically, a section of a propeller blade, looking toward the hub, with the direction of motion of the section, the pitch angle, leading and trailing edges and the up-stream and thrust faces clearly designated.

The air pressure is, of course, distributed, although not evenly, over the entire thrust face of each propeller blade when the propeller is in action and the whole blade section is pushed "up stream," the resultant of all distributed pressure acting through the center of pressure C. P. of the section, as shown. Strangely, however, this center of pressure is nearer the leading edge of the blade than the center of gravity C. G., because of the necessary shaping of the blade, and, consequently, the resultant pressure, acting through the lever arm L, tends to twist the section in a counter-clockwise direction.

The result of this is an increase of pitch angle and consequent increase of torque and drag and a slowing down of the engine. Furthermore, the greater the propeller thrust, the more pronounced this effect will be, which is just the reverse of what is desired as, for maximum efficiency, the pitch angle should decrease as the thrust increases.

By practising my invention, I have provided a propeller in which the leading edges of the blades may be made rigid enough to hold up and allow the trailing edges to deflect relatively more than the leading edges, when the thrust comes on, so that the pitch angle will be decreased as desired, instead of being increased as the thrust is increased.

Obviously, while I have disclosed one method of practising my invention and have specified the employment of certain materials, properly localized, in the body of the propeller, it will be clear that various changes, both in the method of forming the propeller and in the materials employed, are possible. No limitations are, therefore, to be imposed upon my invention, other than those specified in the claims.

I claim as my invention:

1. A variable-pitch propeller comprising a propeller body having its leading edges stiffened.

2. A variable-pitch propeller comprising a propeller body having its leading edge portions formed of stiffer material than the remaining portions.

3. A variable-pitch propeller comprising a propeller body of superimposed layers of fibrous material impregnated with a hardened binder, the fibrous material constituting portions of the body being of greater stiffness than that constituting the remaining portions of the body.

4. A variable-pitch propeller comprising a propeller body formed of superimposed layers of fibrous sheet material impregnated with a hardened condensation product, as a binder, the sheet material in the leading edge portions being of greater stiffness than that in the remainder of the body.

5. A variable-pitch propeller comprising a propeller body formed of superimposed layers of fibrous sheet material impregnated with a binder, localized portions of the sheets being of one material while the remaining portions are of another material.

6. A variable-pitch propeller comprising a propeller body formed of superimposed layers of fibrous sheet material impregnated with a hardened phenolic condensation product as a binder, those layers of sheet material forming the leading edge portions of the body being of paper and the remaining portions of the body being of woven material.

In testimony whereof I have hereunto subscribed my name this 21st day of Dec., 1918.

LOUIS T. FREDERICK.