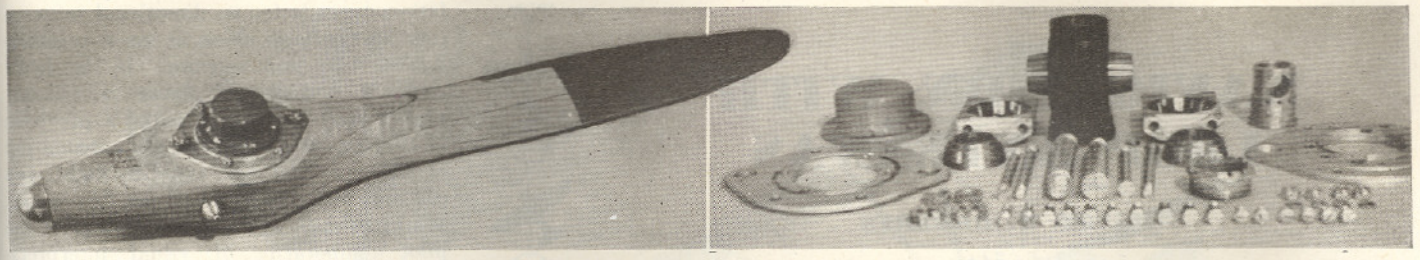

Everel single blade propeller, complete with hub, and (right) the individual metal parts comprising the hub unit

Principles of the Single Blade Propeller

WALTER W. EVEREL

● The Everel single blade propeller is a statically- and dynamically-balanced unit, the blade being balanced by a suitable counterweight. The line passing through the center of gravity of the blade and center of gravity of the counterweight passes through the center of rotation as shown in the diagram figure 1.

The weight of the blade multiplied by the radius, R, to the center of gravity is equal to the weight of the counterweight end multiplied by the radius, R_1, to its center of gravity. This permits static and dynamic balance in all conditions of operation.

Aerodynamic thrust is balanced by the centrifugal force of the propeller, eliminating the transmission of bending stresses to the hub and considerably reducing bending moments within the blade. In the conventional propeller the maximum bending moment occurs at the hub, while in the single blade propeller it occurs at the aerodynamic center of pressure of the blade and is of smaller magnitude than the bending moment at the center of pressure of an equivalent two-blade propeller.

The Everel propeller is of the automatic variable pitch type, this feature being obtained by means of an axis (*B-B* in figure 1) within the hub about which the blade is free to move. This axis is set at a suitable angle to the center line of the blade. When the blade deflects forward about this axis, it performs two functions:

Everel propeller used on a 3000-mile test flight in a Taylor "Cub"

1. The air thrust produces a moment about the center of the propeller, causing it to deflect forward. When this forward deflection occurs, the centrifugal force of the propeller also sets up a moment about the propeller center to balance the air thrust moment. The blade will deflect forward only as far as is required for the centrifugal force moment to equal the air thrust moment. This condition is shown in figure 2, in which the fulcrum (F) represents the intersection of the propeller movement axis and the center of rotation.

The following equation demonstrates the balance of forces existing in the propeller:

Thrust $\times$ r_2 + counterweight aerodynamic drag $\times$ r_1 = CF counterweight $\times$ Lever Arm ab + CF of Blade $\times$ Lever Arm cd.

(Thrust) $r_2 + D \times r_1 = CF$ counterweight $\times$ $r_1 \sin \theta + CF$ Blade $\times$ $r \times \sin \theta$ where θ equals the angle of deflection.

2. The pitch of the blade decreases when the forward deflection occurs thus permitting the engine to turn faster, and aiding take-off and climb. As the ship increases its airspeed, the aerodynamic thrust becomes lighter and the centrifugal force of the propeller reduces the amount of blade deflection, thus increasing the pitch. The increased pitch in the condition of lower air load permits better cruising and maximum speeds. This characteristic is also desirable for altitude flying. In summing up the preceding paragraph, the forward deflection of the blade reduces the pitch; and conversely, the rearward deflection increases the pitch.

The single blade propeller can be designed to operate at a more efficient angle of attack than the fixed pitch two-blade propeller; that is to say it operates closer to the maximum L/D point of the airfoil characteristics. If a two-blade propeller were designed to operate at this point when flying at maximum speed, the take-off performance would be comparatively poor.

It has been proven experimentally that the slipstream straightens out fairly well in one revolution of the propeller. This is the condition that permits the single blade to turn in undisturbed air.

The above mentioned factors account for the increased efficiency in performance of the single blade propeller which is now being produced under a Department of Commerce approved type certificate by the Everel Propeller Corp. in Lancaster, Pennsylvania.

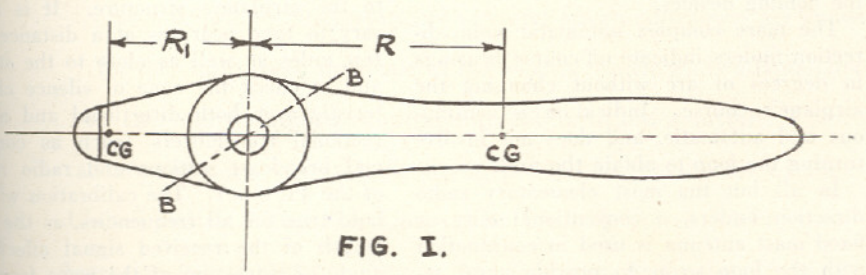

FIG. I.

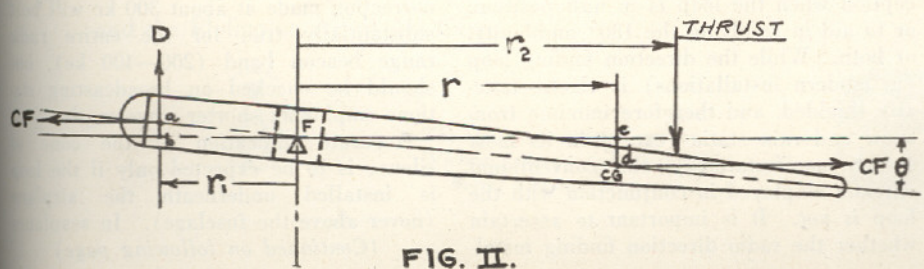

FIG. II.