July 28, 1925. 1,547,644

V. CRONSTEDT

AEROFOIL

Filed Oct. 31, 1921

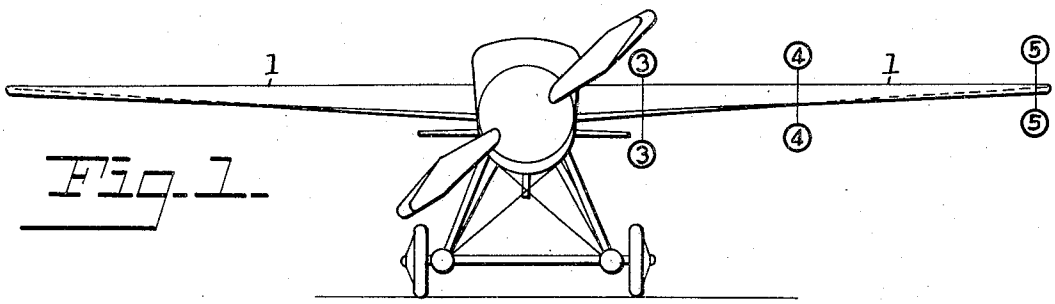


Fig. 1.

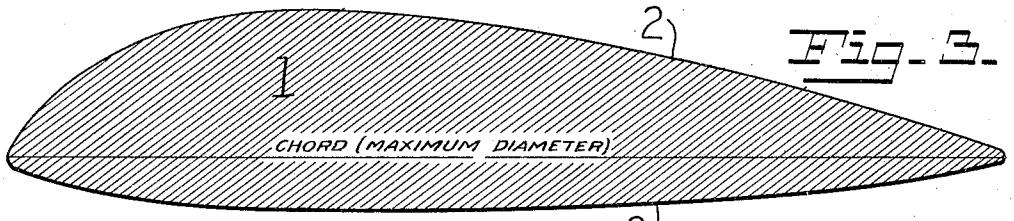


Fig. 3.

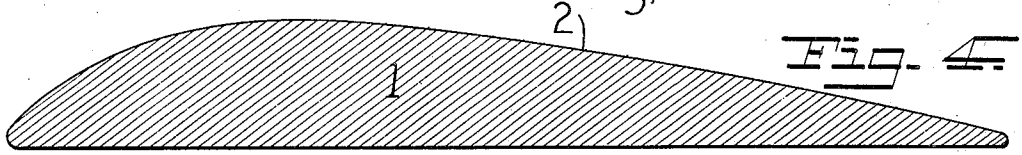


Fig. 4.

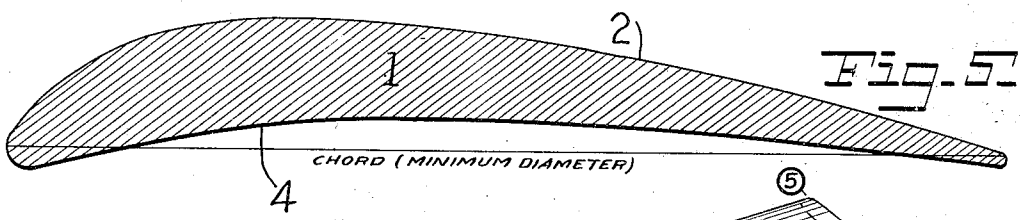


Fig. 5.

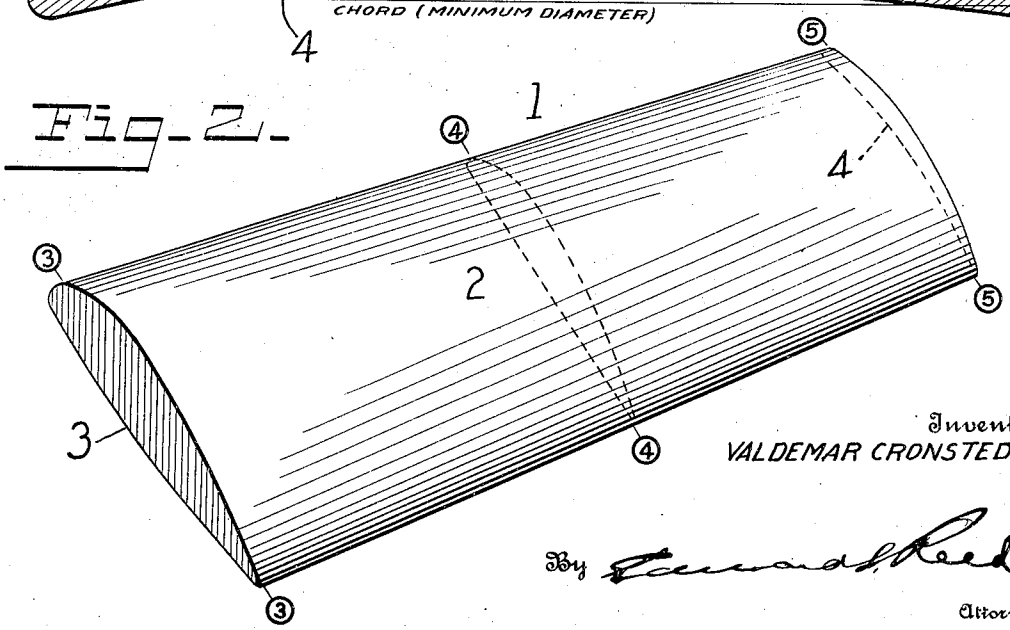


Fig. 2.

Inventor
VALDEMAR CRONSTEDT.

By Edmund Reed

Attorney

Patented July 28, 1925. 1,547,644

UNITED STATES PATENT OFFICE.

VALDEMAR CRONSTEDT, OF LANSDOWNE, PENNSYLVANIA, ASSIGNOR TO FEDERAL ENGINEERING COMPANY, OF PHILADELPHIA, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

AEROFOIL.

Application filed October 31, 1921. Serial No. 511,751.

To all whom it may concern:

Be it known that I, VALDEMAR CRONSTEDT, a subject of the King of Sweden, residing at 27 Highland Avenue, Lansdowne, in the county of Delaware and State of Pennsylvania, have invented certain new and useful Improvements in Aerofoils, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to an aerofoil for airplanes and the like, and more particularly to a wing structure for an airplane.

The load supporting capacity, or "lift," of an aerofoil is partly dependent upon the shape thereof and the object to be attained in aerofoil design is a maximum of lift and a minimum of resistance to forward movement, commonly known as "drag." At a given speed the action of the air stream upon the convex-concave aerofoil, as now generally used, is such as to impart to the same a high lift and also a high drag. On the other hand an aerofoil which is convexo-convex in cross section with its maximum diameter near the lower surface thereof will have a low drag and a correspondingly low lift and will, therefore, require an air flow of higher speed in order to attain and maintain the desired lift. Neither construction is practical for commercial airplane work.

The purpose of the present invention is to provide an aerofoil which will combine within itself the desirable characteristics of both the above mentioned types, thus producing an aerofoil having a relatively high lift and a relatively low drag.

A further object of the invention is to provide such an aerofoil which will be simple in its construction and of a strong, durable character.

In the accompanying drawings Fig. 1 is a front elevation of a monoplane embodying my invention; Figs. 2, 3, 4 and 5 are diagrammatical views of a portion of the aerofoil and Fig. 2 shows a portion of the aerofoil in perspective; Fig. 3 is a section taken on the line 3—3 of Fig. 2; Fig. 4 is a section taken on the line 4—4 of Fig. 2; and Fig. 5 is a section taken on the line 5—5 of Fig. 2.

In these drawings I have illustrated one embodiment of my invention and have shown the same as embodied in the wing structure of a monoplane, in which the aerofoil is of the internally braced type. It will be understood, however, that the invention may be employed in airplanes of various kinds and that the aerofoil may be of any suitable construction and material so long as it has the essential characteristics of shape herein set forth.

In carrying out my invention and in order to secure the desired characteristics of high lift, low drag, and high lift drag ratio $\left(\frac{\text{lift}}{\text{drag}}\right)$ under all load and speed conditions, I so construct the aerofoil that different portions thereof are of different cross sectional shape and so dispose these portions with relation one to the other and to the propeller that they produce an aerofoil having the desired characteristics. In the particular aerofoil, 1, here shown, one portion thereof Fig. 3, has its upper surface 2 curved upwardly from its front edge to its rear edge and has its lower surface 3 curved downwardly from its front edge to its rear edge, so that this portion of the aerofoil is convexo-convex in cross section. The maximum diameter of the section, or the line on which the upper and lower surfaces meet, is arranged nearer the bottom surface than to the top so that the convexity of the lower surface is less than the convexity of the upper surface of the section. The action of the air stream upon a section of this shape is such as to produce a low lift and a very small drag. It will be understood by an inspection of the drawings that the curves of the upper and lower surfaces of the section are not described about fixed axes but are irregular in shape so that the greatest thickness of the section is in front of the longitudinal center line of the aerofoil. Another portion of the aerofoil, which is located at some distance from the section of Fig. 3 has its upper surface 2 curved upwardly from its front edge to its rear edge and conforming substantially to the upper surface of the section of Fig. 3. (Fig. 5.) The lower surface 4 of this portion of the aerofoil is also curved upwardly from its front edge to its rear edge, thus imparting to this portion of the aerofoil a convexo-concave shape in cross section. As has been explained, an aerofoil of this shape has a relatively high lift but also a relatively high drag. The intermediate portions of the aerofoil, that is, those

portions lying between the sections of Fig. 3 and Fig. 5 are of different shapes and, preferably, they gradually change from the shape of the section of Fig. 3 to the shape of the section of Fig. 5, thereby providing the aerofoil with a continuous lower surface, each successive portion of which is of a cross sectional shape different from the cross sectional shape of the adjacent portions. In the form here shown that portion of the aerofoil substantially midway between the sections of Fig. 3 and Fig. 5 has its lower surface extending in substantially a straight line from the leading edge to the trailing edge of the aerofoil. It will be understood, however, that the cross sectional shape of different portions of the aerofoil may vary greatly from those here shown and that their arrangement relatively one to the other may also vary. As a matter of fact, these shapes and arrangements will vary according to the particular work for which the aerofoil is designed.

The convexo-convex portion of the aerofoil having a relatively low lift and requiring for its operation an air flow of relatively higher speed, it is preferable that this portion of the aerofoil should be adjacent to the propeller, because the air stream in the vicinity of the propeller has a higher speed than it has toward the other end of the aerofoil. The convexo-concave portion of the aerofoil has a relatively high lift and will operate satisfactorily in an air stream of less speed and is therefore preferably placed away from the propeller slip stream; and this arrangement of the two sections of the aerofoil with the upper and lower surfaces of the aerofoil as a whole converging from the convexo-convex section to the convexo-concave section produces an aerofoil having a relatively high lift and a relatively low drag which, as has been stated, is the ultimate purpose to be attained in a structure of this kind.

While I have shown and described one embodiment of my invention I wish it to be understood that I do not desire to be limited to the details thereof as various modifications may occur to a person skilled in the art. Further it will be understood that while the invention is designed primarily for use in airplane wings, it is not confined to airplanes but may be employed in connection with other structures, such for example as the fins of a submersible boat.

Having now fully described my invention what I claim as new and desire to secure by Letters Patent is:

1. An aerofoil comprising an elongated member having two non-adjacent portions, one of said portions being convexo-convex in cross section and the other of said portions being convexo-concave in cross section.

2. An aerofoil comprising an elongated member having two non-adjacent portions, one of said portions being convexo-convex in cross section and the other of said portions being convexo-concave in cross section, and intermediate portions having cross sectional shapes between the extremes represented by the first mentioned portions.

3. An aerofoil comprising an elongated member having two non-adjacent portions, one of said portions being convexo-convex in cross section and the other of said portions being convexo-concave in cross section, and having its upper and lower surfaces converging from said convexo-convex portion toward said convexo-concave portion.

4. An aerofoil having a substantially uniform upper surface, said surface being curved upwardly from its front edge to its rear edge, and having a continuous lower surface, one portion of which is curved downwardly from its front edge toward its rear edge and another portion of which is curved upwardly from its front edge toward its rear edge.

5. In an airplane, an aerofoil comprising an elongated member having a portion convexo-convex in cross section arranged adjacent to the propeller and having a portion convexo-concave in cross section arranged at a point remote from the propeller.

6. In an airplane, an aerofoil comprising an elongated member having a portion convexo-convex in cross section arranged adjacent to the propeller and having a portion convexo-concave in cross section arranged at a point remote from the propeller, the lower surface of said aerofoil changing gradually in shape from the convex portion to the concave portion thereof.

In testimony whereof, I affix my signature hereto.

VALDEMAR CRONSTEDT.