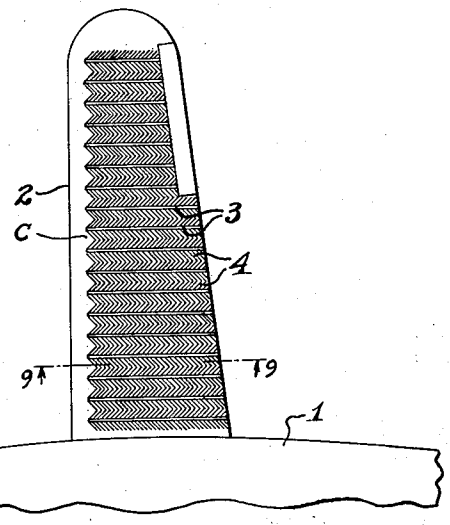
March 12, 1935. H. W. NELSON 1,994,045

AIRPLANE

Filed June 16, 1932

Fig 1



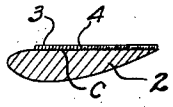


Fig 9

Fig 4

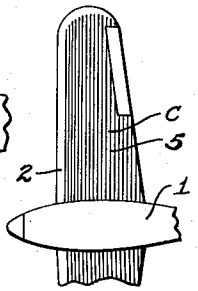
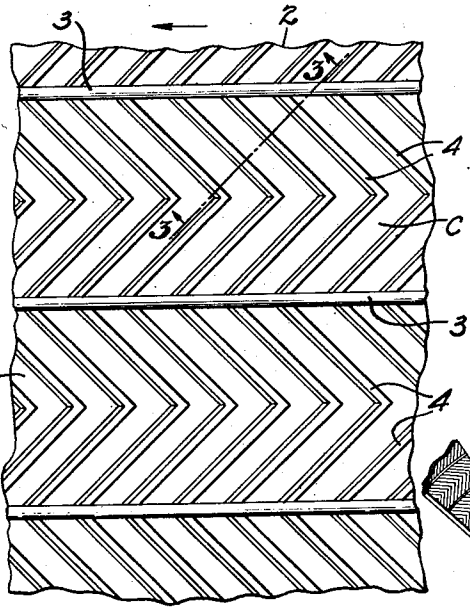


Fig 2



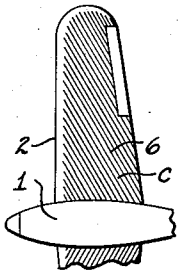


Fig 5

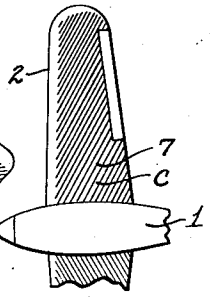


Fig 6

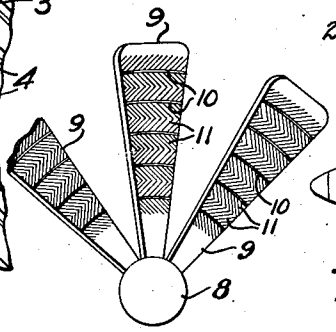


Fig 7

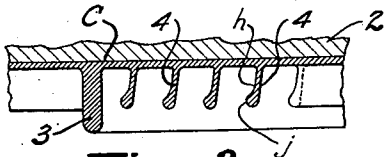


Fig 3

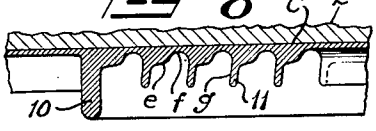


Fig 8

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Patented Mar. 12, 1935 1,994,045

UNITED STATES PATENT OFFICE

1,994,045

AIRPLANE

Henry Wade Nelson, New York, N. Y.

Application June 16, 1932, Serial No. 617,497

1 Claim. (Cl. 244—12)

My invention relates to improvements in airfoils and more especially airfoils which are adapted primarily for airplanes and has for its principal objects the provision of an airfoil of the same general contour of the standard airfoil but which has a materially increased

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efficiency as compared therewith because of the fact that the under surface thereof, instead of being formed substantially smooth, is provided with depending ribs or corrugations which extend at an angle to the line of flight. Further advantages of the invention will hereinafter appear.

When a plane supporting a weight moves through the air, the weight will constantly deviate the plane from a course in its own direction, and the line of flight will therefore be at an angle to the plane itself. Due to this "falling" tendency of the plane during flight, an air pocket or a vacuum will form on the upper side of the plane, while the air under the plane will be compressed. Accordingly, the air in front of the plane will tend to rush in and occupy the existing vacuum on the upper side of the plane and an air current directed against the moving plane will exist on that side of the plane. Moreover, the air in being compressed on the under side of the plane and in front thereof will assume a velocity in the direction of flight.

Now it will be apparent that when the surfaces of the plane are each smooth, the air passing over the upper surface of the plane as well as the air on the under side thereof, will possess a downward motion as well as a rearward one and these two motions will so balance each other that a pressure at right angles to the plane will arise, all in accordance with the accepted law of physics that a fluid pressure on a surface is always exerted at right angles to the surface.

It is necessary, because of structural considerations, to make the supporting planes of an airplane of considerable thickness and it has been demonstrated that the so-called airfoil section which has a blunt nose, a convex upper surface tapering off towards the rear and a flat or slightly concave lower surface converging at the rear with the upper surface causes the least resistance to movement through the air. Therefore, the angle between the direction of flight and the under side of the airfoil of a plane in flight is considerably less than that of the upper side thereof and as a consequence, the principal lift force, some 65% total lift exerted, is due to the suction exerted on the upper surface of the airplane, while the under side of the airfoil becomes idle as far as lifting is concerned.

In the preferred embodiment of my invention, I retain the present smooth construction of the upper plane surface and I therefore obtain all the lifting force of the present plane. I have, however, discovered that by providing the undersurfaces of a flying craft with a series of properly designed baffles or vanes, it is possible to convert the idle under surfaces into active supporting and driving agents during flight. Now, therefore, when these under surfaces are enabled to do their share of the flight support, it follows that the plane speed necessary for suspension can be considerably reduced.

In this connection, it is to be noted as a well known fact pertaining both to planes and boats moving in a fluid, that the higher the speed the less the engine economy. This is because the frictional fluid resistance as well as the displacement resistance in a fluid varies as the square of the velocity and the engine power required to overcome the same will vary as the third power thereof.

As my invention enables me to actually fly at a considerably reduced speed, the frictional, as well as the displacement resistance become so small as to be almost negligible, and all the power becomes transformed into lift proper and support of flight. The present flying is achieved at a high velocity and therefore done by brute force at great sacrifice of power, while my method of flight is entirely different as the suspension is accomplished at a moderate speed of progress without excessive expenditure of power.

In my preferred apparatus the under plane surfaces are provided with a system of vanes which gather in the passing air currents and guides the currents into channels in a way which converts their energy into supporting and driving power for the plane.

This object is achieved by means of providing the under surfaces of my preferred flying apparatus with a series of vanes disposed in parallel rows and directed diagonally backwards where they converge with another series of diagonal vanes similarly arranged.

This construction of converging vane rows in pairs, preferably being disposed between reinforcing ribs may extend to all the under surfaces of the flying apparatus.

In the accompanying drawing in which I have illustrated several preferred embodiments of my invention

Figure 1 is a fragmentary plan view from below of an airplane embodying my invention and

Fig. 2 is an enlarged fragmentary detail of the airfoil thereof, similarly viewed;

Fig. 3 is a transverse section on the line 3—3 of Fig. 2 when the airfoil is in its normal position;

Fig. 4 is a fragmentary plan view, viewed from below, of an airplane equipped with an airfoil embodying a modified form of my invention;

Figs. 5 and 6 are similar views showing still further modifications of my invention;

Fig. 7 is an elevation of a rotor having blades embodying my invention, the same being adapted for a wind-mill or other purposes;

Fig. 8 is a fragmentary vertical section corresponding to the section shown in Fig. 3, but showing a still further modification of my invention wherein the base of the channels between adjacent corrugations is of special curvilinear configuration; and

Fig. 9 is a vertical section along the line 9—9 of Fig. 1 and serving to show the airfoil contour of the wing.

Referring to the drawing and the construction shown therein, the reference numeral 1 designates a fuselage of an airplane and 2 a wing thereof which, as shown in Figs. 1 and 9 is preferably of airfoil contour. The lower surface *c* of said airfoil is provided with a plurality of transverse main ribs 3 intermediate which converging diagonal vanes 4 project, which preferably meet in the center line intermediate said main ribs 3.

In the construction shown in Fig. 4, the vanes 5 which generally correspond to the vanes 4, extend in parallelism with each other and substantially longitudinally of the wing, whereas in Fig. 5, the vanes 6 which also are of similar construction to those shown in Figs. 2, 3 and 4, are parallel with each other and extend at an oblique angle to the longitudinal axis of the airfoil and in Fig. 6, the vanes 7, though similar to those shown in Fig. 5, extend obliquely in an opposite direction to that in which the vanes 6 extend.

In Fig. 7, the reference numeral 8 designates a hub of a fan or rotor member and 9 the blades thereof, the latter being provided with ribs 10 and converging, obliquely-extending vanes 11, generally similar to those shown in Fig. 2.

In the construction shown in Fig. 8, the base of the channel formed between adjacent vanes 11 is in a form of an ogee curve, the portion *e* of which is of convex curvature and the portion *f* which is in advance of the leading face of the adjacent vane is of concave curvature.

It is preferable that the vanes 4 project at a slight inclination to a perpendicular line projected from the transverse axis of the airfoil, as illustrated in Figs. 3 and 8, as thereby the rear wall, such as *g* or *h* has a more positive trapping or pocketing action upon the air which spills over from one vane 4 into the channel immediately to the rear thereof and consequently, as hereinafter explained, a more positive lifting effect is obtained. In Fig. 3, the lower ends *j* of the vanes are somewhat enlarged on their rear faces in order to further assist in trapping such air and thereby further enhance the lifting action obtained.

It is preferable that all of the under surfaces of an airplane, including even the fuselage, be provided with my improved system of vanes, as thereby the passing air currents are gathered up and guided into the various channels which serve to convert their force into a supporting as well as driving power for the plane.

In general, the vane system which I provide for the wings, and if desired, the fuselage also functions like the feathered surfaces of a bird, including the body, wings and tail, whose flying efficiency is generally recognized as almost perfect.

In fact many birds are capable of soaring and even rising in an almost motionless atmosphere. Their flight is accomplished through the rapid flapping of their wings at the rate of some six times and even more per second, whereby they bring into action what might be fittingly termed their vane machines, producing support as well as motive power on the downward thrust of the wings and on the upward thrust, owing to the supporting power of the under surfaces of vane machines on the wings, body and tail, they descend but slightly if at all. In the flight of birds, the vacuum effect hereinbefore noted, while effective, has a supporting agency in all likelihood which is but secondary to the work of their so-called vane machines which cover their entire lower surfaces.

As a result of my invention I have succeeded in bringing two new forces of support into action on the under plane surfaces, while retaining all the full and undiminished lifting power of the upper smooth plane surface. The theoretical explanation thereof is as follows:—When a plane moves forward, as previously explained, the air in front thereof in being compressed will pass laterally outwards over the edges of the plane, while additional air will be sucked in laterally over the plane edges back of the plane. If, therefore, the lateral movement of the air is prevented by means of baffles or vanes disposed only along some, but not all of the plane edges, the air would escape over the remaining edges with an increased intensity. In my preferred construction I have provided a series of baffles or vanes all set at a considerable angle to the direction of flight, and by reason thereof air is being compressed in front of said vanes and being sucked in behind them. A lateral air motion therefore takes place during flight, the air moving downwardly from the plane in front of the vanes and upwardly towards the plane at the rear of the vanes. Consequently a series of alternating lateral air currents will exist on the under side of the plane, which currents cause a pressure to exist on the under side of the plane proper, inasmuch as the air is either pressed out from this surface or its motion is stopped by the baffle action of the plane surface. This pressure effect is herein referred to as the swirl support of the plane.

Also in my preferred apparatus where I employ the converging vane rows it will be readily understood that the air currents, due to flight, must be entrapped by the vane channels and carried therethrough until they converge with each other, whereupon, due to the temporary halting of their rearward motion, the resulting surplus of pressure will cause the air to escape rearwardly over the converging edges of the vanes and will spill over into the channel immediately to the rear of such vanes and which air, being highly compressed by virtue of its converging travel, will impact with force against the bottom of the underside of the plane and will not only materially assist in supporting the plane, but also assist in driving the plane forward. This upwardly and forwardly directed driving force of such compressed air is herein termed surge force.

It is to be noted that in my invention a minimum of power is required for suspension in flight and therefore a smaller and lighter engine can be employed notwithstanding the fact that the flying apparatus so equipped with my improvement will have an increased load-carrying capacity.

The dimensions of the vanes and the spacing thereof from each other as compared with the size of the surfaces carrying the same are rela-

tively minute, being but a small fraction of an inch and preferably the extreme height of the vanes, i. e. the extent to which they project from the surface, as well as the spacing between adjacent vanes, does not exceed about ¼ inch, although obviously the exact dimensions of the vanes and the spacing thereof is a variant depending principally upon the size and normal speed of the particular plane equipped therewith. However, the exact height of the vanes, as well as the spacing thereof, can be readily determined by trial, but in no event, of course, should these dimensions be so large that the normal

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efficiency of the plane is reduced as the result of the provision of such vanes on the lower surface of the air plane.

Various modifications within the scope of the appended claim may obviously be made without departing from the spirit of my invention.

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

An airplane adapted for sustained flight, having a plurality of minute reinforcing ribs extending in the direction of flight, two rows of parallel vanes disposed between each pair of adjacent ribs and vanes of the adjacent rows converging in pairs diagonally rearwardly and intersecting each other, said vanes being of substantially lesser height than the height of the respective ribs and the bottom of the channels formed between the two adjacent vanes being of a curvilinear configuration and of greatest depth in proximity to the leading edge of each vane.

HENRY WADE NELSON.