

A. G. LEIGH.
AEROPLANE WITH INHERENT STABILITY.
APPLICATION FILED FEB. 25, 1919.

1,404,129.

Patented Jan. 17, 1922.

3 SHEETS—SHEET 1.

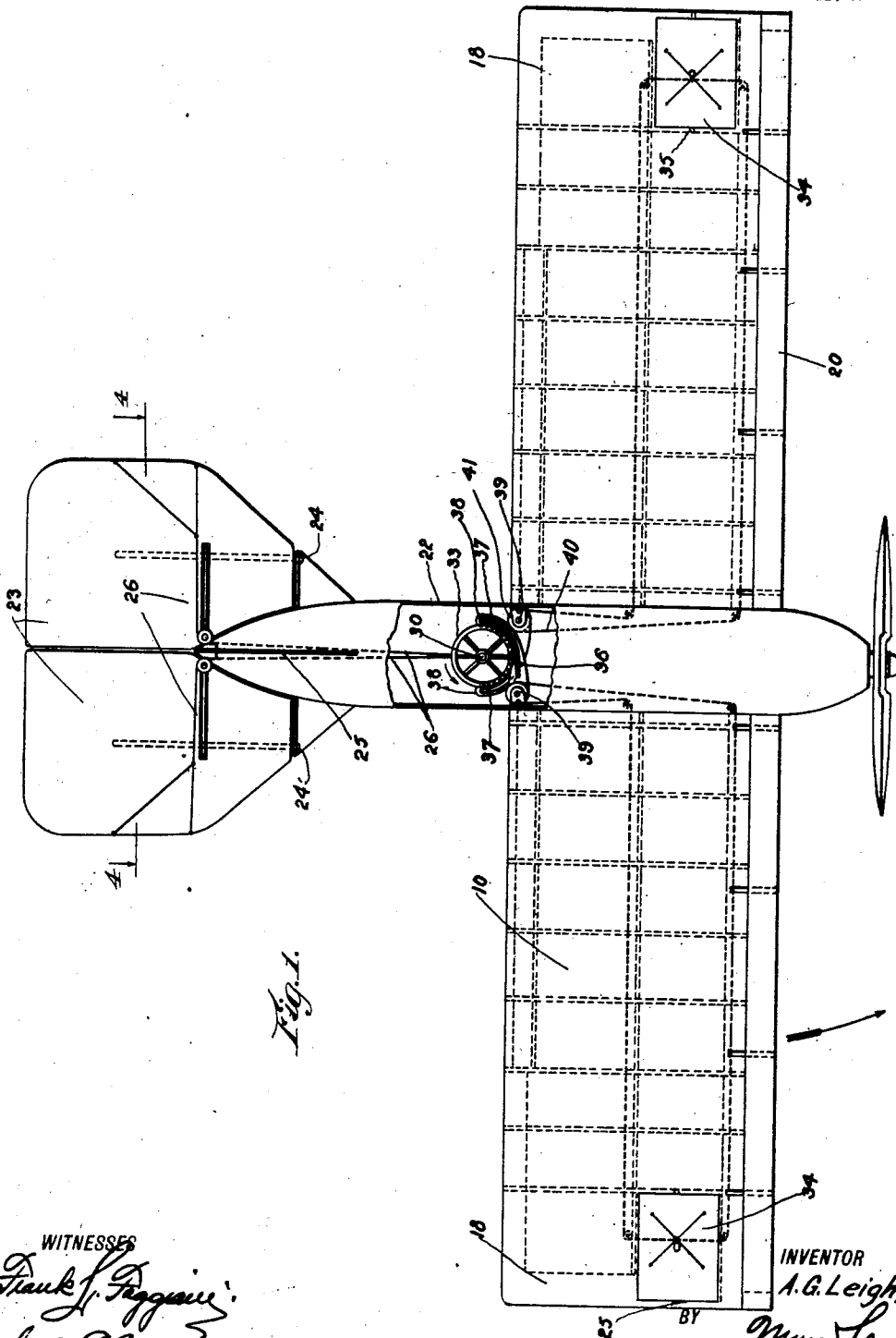


Fig. 1.

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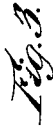
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3 SHEETS—SHEET 2.



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3 SHEETS—SHEET 3.

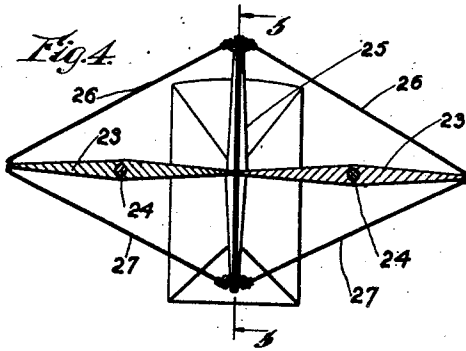
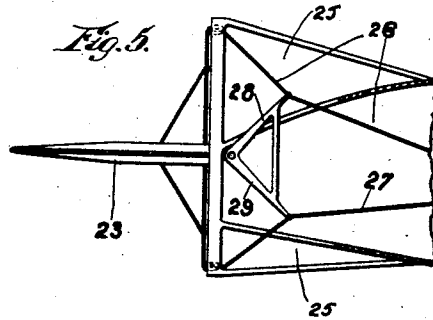


Fig. 6.

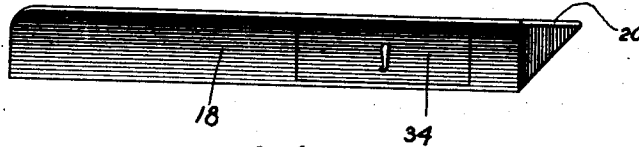


Fig. 7.

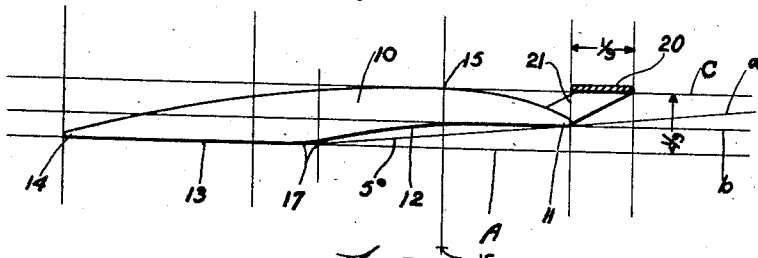


Fig. 8.

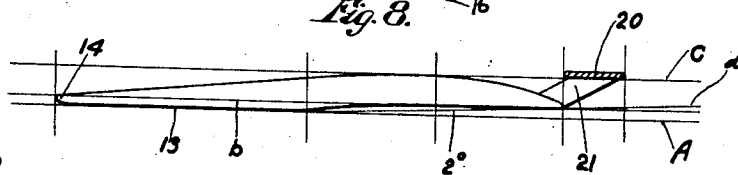
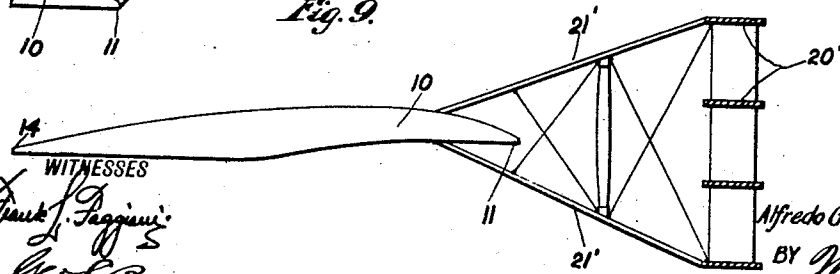


Fig. 10.



Fig. 9.



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AEROPLANE WITH INHERENT STABILITY.

1,404,129.

Specification of Letters Patent. Patented Jan. 17, 1922.

Application filed February 25, 1919. Serial No. 279,074.

To all whom it may concern:

Be it known that I, ALFREDO GUILLERMO LEIGH, a citizen of Chile, and a resident of Carmen 169, Santiago, Chile, have invented a new and Improved Aeroplane with Inherent Stability, of which the following is a full, clear, and exact description.

This invention relates to aeroplanes and has particular reference to a new construction or design having in view the maximum degree of inherent stability due to the shape and construction of the wings.

Another object of the invention is to construct an aeroplane whose behavior in the air will more nearly simulate the flight of a bird than will any other design of aeroplane.

More definitely stated among the objects of the present invention is to so construct the wings of an aeroplane as to make practical and feasible the use of a very much shorter body and tail than has heretofore been accomplished, the wing structure being such that the steering devices may be located entirely in or adjacent to the wings instead of at the tail as heretofore.

A further object of the invention is to provide an aeroplane whose wings shall establish in the machine such inherent stability for sailing or flying through the air that the only tail controlling means that is needed is the elevator for controlling the lifting and lowering of the machine.

A still further object is to provide an aeroplane with one or more main lifting planes arranged either in the same or different planes, but of low aspect ratio, and associated with the main plane or planes are one or more high aspect ratio planes in the same or different planes, but having a peculiar relationship to the main lifting plane or planes.

Another object of the invention is to provide novel tail controlling means for aeroplanes.

With the foregoing and other objects in view the invention consists in the arrangement and combination of parts hereinafter described and claimed, and while the invention is not restricted to the exact details of construction disclosed or suggested herein, still for the purpose of illustrating a practical embodiment thereof reference is had to the accompanying drawings, in which like

reference characters designate the same parts in the several views, and in which—

Figure 1 is a plan view of my present improvement, parts being broken away to disclose features that would otherwise be hidden.

Fig. 2 is a front elevation of the same.

Fig. 3 is a side elevation with parts in longitudinal section.

Fig. 4 is a horizontal section of the tail on the line 4—4 of Fig. 1.

Fig. 5 is a longitudinal section on the line 5—5 of Fig. 4.

Fig. 6 is an edge or end view of the main lifting plane and its automatic lateral stabilizer.

Fig. 7 is a diagram representing the preferred form in cross section of the main lifting plane of a low speed machine and indicating the preferred form and relative location of the auxiliary plane of high aspect ratio that is utilized to effect automatic stability longitudinally or in the direction of the line of flight.

Fig. 8 is a view similar to Fig. 7 but showing the preferred form of the main lifting plane for a high speed machine.

Fig. 9 is a diagram showing a modified arrangement of high aspect ratio planes; and

Fig. 10 is a detail view indicating a modified location of the high aspect ratio plane with respect to the leading edge of the main lifting plane.

Referring now more particularly to the drawings I show my invention as embodied in a monoplane machine, but with the understanding that certain features thereof are applicable to other types of airplanes. In the form shown the main lifting plane is indicated at 10 and may be described as comprising two wings arranged in the same plane but projecting laterally in opposite directions from the vertical central longitudinal plane of the machine. The main portion of the plane 10 is of uniform cross section throughout its length and comprises the following features: A leading edge 11, a cambered under surface 12 leading rearward from said edge 11 to about the middle of the plane and from which a flat portion 13 leads to and terminates in a rear edge 14. The plane surface 13 coincides with an imagi-

nary plane *a* parallel to the line of flight. The leading edge 11 lies in an imaginary plane *b* approximately midway between the plane *a* and another parallel plane *c* tangent to the convex upper surface of the lifting plane substantially at a point 15 in which the center of gravity or center of pressure of the machine as at 16 is located somewhere either within the main plane or below it, preferably the latter. The point of intersection between the cambered surface 12 and the flat surface 13 is approximately at 17 and in the regular machine, as distinguished from the high speed machine, an imaginary plane *d* intersecting the leading edge 11 and the point or line 17 diverges from the plane *a* at about 5 degrees. The normal lifting action incident to the flight of the machine through the air is effected largely against the flat surface 13 as a result of the cavitation above the rear half of the plane 10 due to the crown of the plane at its forward half.

Rigidly connected to and carried by the end or tip portions of the main plane wings are a plurality of flat planes 18, one at each end, lying in inclined planes *e* (see Fig. 2) intersecting each other in substantially the center of pressure of the machine. These planes 18 constitute the automatic lateral stabilizers and like the plane surface 13 are parallel with or coincide with the direction of flight.

As will be noted best in Fig. 2 the outer end of each wing of the main plane 10 is given a downward curvature at 18^a and thence terminates in a flat portion 18^b, the outer edge of which coincides with the inner or lower edge of the plane 18. I have found by much study and experience that while the plane 18 is of great value with respect to lateral stability, its efficiency is increased by about 50 per cent by reason of the downward dip of the tip ends of the wings as just stated. By this construction I provide an aerofoil character for the lateral stabilizers and materially increase the cavitation effect with a minimum drag in the sidewise movement in such a way that the righting moment movement of this static lateral stability is more efficient and at the same time very easy and gentle, and so the lateral oscillations following the righting moment are not produced, marking a great superiority over such structures wherein there are provided only outward and upward inclined planes.

The inherent longitudinal stability of this machine is provided for by what I term a high aspect ratio plane 20 of which I may employ only one or any other suitable number and in the same plane or in different planes. While the plane 20 is shown in Fig. 2 as being essentially flat I prefer that it be curved upward slightly at its ends adjacent to the lateral stabilizers, whereby the ends

of the plane 20 co-operate with said planes 18 for stability. As shown in Figs. 1 and 2 there is but one high aspect ratio plane 20 coextensive in length with the complete main lifting plane and its lateral stabilizers and being preferably uncambered or flat longitudinally and having its lower surface coincident with the horizontal plane *c* above described. I wish it to be understood, however, that the high aspect ratio plane may be positioned otherwise than as illustrated, that is to say, it may be located at any desired elevation with respect to the leading edge 11 of the main plane, but preferably above it and also at any desired position with respect to the leading edge forward or rearward, but while I indicate in Fig. 7 the relative position of the high aspect ratio plane that is most efficient, such plane may be spaced forward with respect to the leading edge 11 to a distance not to exceed its chord or the combined chords of a plurality of such planes such as indicated at 20' in Fig. 9. Also the high aspect ratio plane 20 may be placed rearward with respect to the leading edge 11 as indicated in Fig. 10. The chord of the high aspect ratio plane should be approximately equal to the perpendicular distance between the planes *a* and *c* which distance should be substantially one ninth of the whole distance between the leading edge of the plane 20 and the rear edge 14 of the main plane, while the center of gravity or pressure should be approximately in the vertical line or plane one third of the way between the last mentioned lines. The same set of facts apply essentially to the modified structure in Fig. 9 in that the distance between the leading edge 11 of the main plane and the high aspect ratio planes should not exceed the combined widths or chords of the latter mentioned planes and also the center of gravity in this assemblage while possibly being advanced to or ahead of the leading edge 11 should be, as above stated, somewhere in a vertical transverse plane located at one third of the distance from the leading edges of the planes 20' to the rear edge 14. The high aspect ratio plane or planes are rigidly secured to and carried by the main lifting plane by any suitable means such as braces 21 or 21' so as to afford the least possible resistance. Any tendency for the machine to tumble forward is immediately and automatically resisted and counteracted by the high aspect ratio plane or planes.

In Fig. 8 the diagram of the high speed machine is so modified from that of Fig. 7 as to indicate that the angle between the planes *a* and *d* should be approximately two degrees instead of five. This modification of vertical dimension between the planes *a* and *b* makes a corresponding lowering of the high aspect ratio plane with respect to

the plane surface 13, but otherwise the conditions are essentially the same as described in detail in connection with Fig. 7.

Whereas I assert and have proved by extensive practice that my aeroplane wings possess inherent stability both laterally and longitudinally it follows that the body 22 and tail planes 23 of the machine may be materially shorter than in the ordinary type of aeroplanes. Said tail planes 23 are movable around horizontal parallel axes 24, but normally are both substantially horizontal in ordinary flight. Any suitable means may be provided to control the action of the tail planes with respect to the fin 25, but for this purpose I indicate wires 26 and 27 leading respectively from the upper and lower surfaces of the tail planes past arms 28 and 29 of the elevator to a lever 30 mounted to swing around a transverse horizontal axis 31 in a relatively fixed support 32 within the body 22. Said wires or other flexible connections are attached respectively below and above the axis 31 so that the operator seated in the body at the rear of the lever 30, by grasping the wheel 33 may draw rearward upon the wheel in the most natural direction to adjust the tail planes to cause the upward tilting of the machine.

In the use of the elevator and with reference to the alighting of the aeroplane simulating the behavior of a bird, the tail planes 23 are swung simultaneously around the fore and aft parallel axes 24 to or toward vertical planes. This action of the tail planes relieves them from what may be termed upward static pressure and so the tail portion of the machine has a tendency to drop causing the center of gravity to pass rearward and the upward tilting of the leading portion of the machine. This is precisely what occurs when a bird alights on a perch or the ground. The forward movement of the object is thus materially retarded by the increased resistance occasioned by the upward tilt of the front part and downward tilt of the rear part thereof. In my practice furthermore I stop the power to make this stopping or "sitting" action more effective. When the machine is to be started or lifted from the ground a similar movement of the tail planes is made with a similar result as to the upward tilt of the front part of the machine, but differing from the alighting action in that the motor will be operated under full or substantially full power to cause the rise of the machine. The foregoing describes the starting, alighting and elevating actions of the machine. To descend from an elevated position the operator simply stops or reduces the speed of his engine and with the consequent slowing up of the forward motion of the machine it will descend. A nose dive with this machine is impossible because of the

features of inherent stability above fully set forth. The tail planes in whatever position they are carried or adjusted always lie parallel with the line of flight and hence offer no head resistance, a matter of importance in flying and in distinguishing my machine from ordinary aeroplanes in which the tail mechanism when swung in a direction transverse or oblique to the line of flight always depends upon the forward resistance for its action.

As above premised no lateral steering devices are required on either the body or the tail. To control the lateral turning or steering of the machine, therefore, I am able because of the inherent stability of the wings to employ one or more retarding devices in the tip end portion of each wing. These retarding devices are shown in the nature of baffles 34, one for each of the wing tips and lying normally flush with the lateral stabilizer 18. In order to cause the lateral turning for instance toward the left as indicated by the arrows on Fig. 1, the baffle 34 at the operator's left is swung around a transverse axis 35 so as to occupy a position perpendicular to the line of flight while the opposite baffle remains undisturbed. The effect of the moved baffle naturally is to retard the adjacent end of the machine or wing causing the machine as a whole to tend to sail around such portion as a pivot. Any suitable means may be provided to cause the effective movement of the baffles severally. To this end I show an arc-shaped arm or frame 36 carried upon the forward side of the lever 30, the curved portion of the arm 36 being concentric with the horizontal axis 31 and having constant engagement in the slots 37 formed in the arc-shaped levers 38 pivoted at 39 upon some suitable fixed parts of the machine. These slotted arms or levers 38 are so designed as to lie normally concentric with the lever 30 while the plane of the arm 36 lies midway between the axes of the arms 38. It will now be seen that if the wheel 33 be operated to the left as indicated in Fig. 1 the arm 36 will be swung toward the operator's left causing the flexible connection 40 operating over a pulley 41 to which the then operated arm 38 is attached, to effect the desired swing of the baffle 34 at the left end of the machine while the arm 36 at such time operating in the slot 37 of the opposite lever 38 will hold the latter from movement. These controlling devices for the two baffles 34 will be understood to be similar in construction and operation so that while either of the baffles is moved from normal position the other baffle will be positively held in normal position.

As above premised by this machine I am able to simulate the flight of a bird, either as a sailing or gliding flight or as a power propelled flight, according to the direction

or force of the wind or other conditions encountered in the air. This feature is of vast importance especially with respect to the conservation of fuel for the aeroplane motors. For example in heavy machines wherein a multiplicity of independent motors may be employed I am able to progress under all atmospheric conditions, and for a considerable portion of the trip one or more of the motors may be stopped to take advantage of the sailing capability of my machine.

I claim:

1. In an aeroplane, the combination of a main lifting plane positioned at the nose end of the machine and a high aspect ratio plane having a high span factor and located adjacent to the leading edge of the said main lifting plane and spaced therefrom a distance not greater than the chord of the high aspect ratio plane, said planes being of substantially equal length and held in constantly rigid relation to each other.

2. In an aeroplane, the combination of a main lifting plane having the front of its under surface cambered, the rear part of its under surface flat and parallel to the direction of movement of the machine, and the upper surface convexedly curved all the way from the leading edge to the rear edge, and an automatic fore and aft stabilizing device carried adjacent thereto.

3. In an aeroplane, the combination of a main lifting plane having a portion of its under surface cambered and another portion flat and lying in a plane parallel to the direction of movement of the machine, while the upper portion is convexedly curved all the way from front to rear, and a high aspect ratio stabilizing plane carried adjacent to the leading edge of the main plane and approximately within the space between the parallel planes defining the top and bottom of the main plane.

4. The herein described aeroplane comprising a main lifting plane, a high aspect ratio stabilizing plane adjacent to the leading edge of the main plane for fore and aft stabilizing, the center of gravity being located approximately in a vertical plane one third of the distance from the leading edge of the high aspect ratio plane to the rear edge of the main plane, and means to stabilize the machine laterally.

5. In an aeroplane, the combination of a main lifting plane having relatively long laterally projecting wings including inherent automatic lateral stabilizing means, a short body having a relatively short tail, an

elevator carried by the tail, and movable only around a horizontal fore and aft axis, and lateral steering devices carried only by the wings.

6. In an aeroplane, the combination of one or more planes having inherent automatic lateral as well as longitudinal stabilizing means, a body, a relatively short tail, an elevator carried by the tail, lateral steering means carried only by the wings, and a single manually controlled member mounted in the body through which the operator may manipulate either the elevator or the lateral steering means independently or conjointly.

7. In an aeroplane, the combination with a body, of two planes at the rear of the body, said planes being pivoted intermediate their widths on axes parallel to each other and to the line of flight, and means for simultaneously operating said planes to swing them into vertical or approximately vertical position.

8. In an aeroplane, the combination of a body, a stationary fin located in the central vertical plane of the body, a plurality of tail planes located on opposite sides of the fin, and means for simultaneously adjusting said tail planes around axes parallel to each other and to the line of flight.

9. In an aeroplane, the combination of a body, an elevator at the tail end thereof, said elevator comprising a plurality of pivoted and juxtaposed tail planes, means to support said planes at all times parallel to the line of flight, and means for swinging the planes simultaneously in opposite directions around longitudinal parallel axes into vertical or approximately vertical positions.

10. The herein described aeroplane with inherent stability comprising a body, a pair of wings extending laterally therefrom, movable lateral steering members carried in the tip ends of the wings and normally parallel to the line of flight, an elevator means movable only around a longitudinal axis, and manually controlled devices to actuate either steering device while the other is held stationary and simultaneously cause movement of the elevator.

11. In an aeroplane, a body, wings extending from the body, a baffle pivotally mounted adjacent the tip of each wing, a pivoted operating lever provided with a curved arm, pivoted curved levers having slots receiving the curved arm of the operating lever, and flexible connections between the curved levers and the baffles.

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