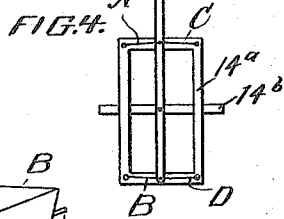
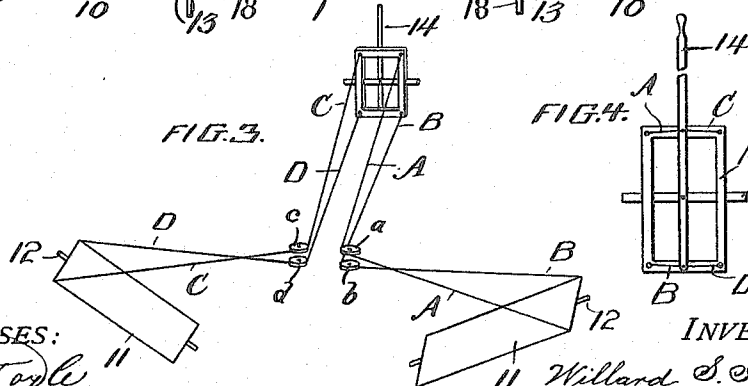
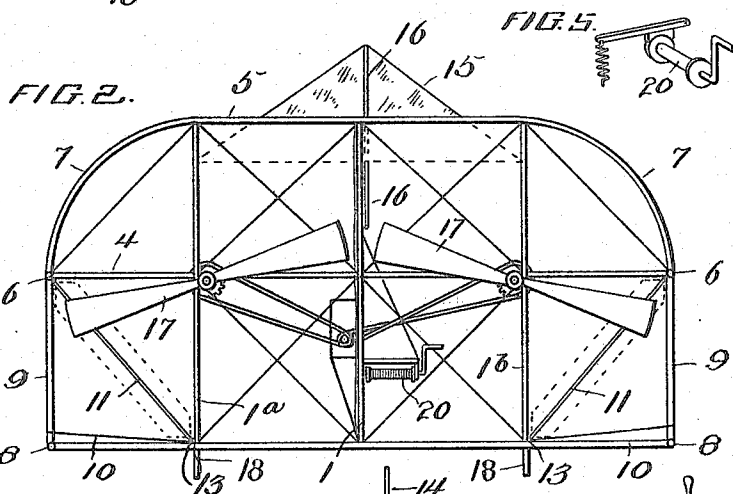
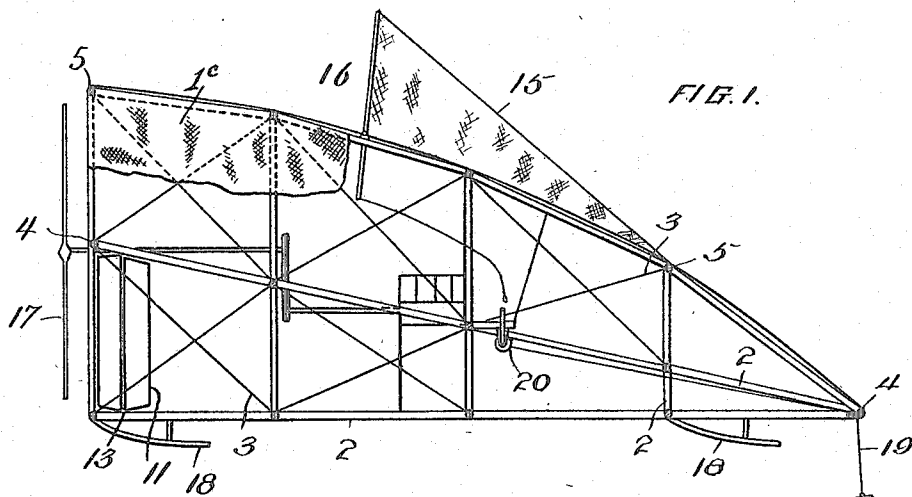


W. S. ISHAM.
FLYING MACHINE.
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1,135,455.

Patented Apr. 13, 1915.



WITNESSES:

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UNITED STATES PATENT OFFICE.

WILLARD S. ISHAM, OF WASHINGTON, DISTRICT OF COLUMBIA.

FLYING-MACHINE.

1,135,455.

Specification of Letters Patent.

Patented Apr. 13, 1915.

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To all whom it may concern:

Be it known that I, WILLARD S. ISHAM, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Flying-Machines, of which the following is a specification.

My invention consists in certain improvements in that class of flying machines termed aeroplanes.

Machines of this class heretofore have risen from the ground only as a consequence of unbalanced air-pressures acting upon their planes resulting from velocity purposely attained while running on wheels or skids along the ground.

My invention consists in part in certain constructions and combinations of parts whereby my aeroplane is raised directly from the ground and permitted to attain its natural speed of flight without the retardation or inconvenience resulting from rails, trucks or irregularities of the ground.

Another feature of my invention consists in an arrangement of parts whereby practically all the air acting directly upon the planes is given a fixed direction and velocity with reference to such planes thereby eliminating in a great measure the prejudicial effect of earth currents.

Another feature of my invention consists in giving to the main plane such a shape as to obtain substantially a uniformly distributed air-pressure throughout its entire area thereby increasing its practical efficiency and stability.

Other features will be taken up after describing the machine which is shown in its preferred form in the accompanying drawings forming part of this specification.

In the drawings,—Figure 1 is a longitudinal section of the machine in its preferred form; Fig. 2 is a front elevation of the said machine; Fig. 3 is a diagram of the controlling device; and Fig. 4 is a detail of the controlling lever. Fig. 5 is a detail of the controllably yielding connection.

The frame of the machine consists of three similar parallel trusses, 1, 1^a and 1^b, composed of rigid and continuous compressive members 2 and diagonal tensile members 3. The truss 1 is located longitudinally at the center of the machine while the other trusses are arranged at each side of the central truss and equi-distant therefrom. These trusses are held at fixed distances by

the rigid and continuous members 4 which are extended to also hold the side rails 6. The rigid and continuous members 5 hold in position the upper chords of the trusses and a complete system of diagonal tensile braces in each panel created by the compressive members completes the main truss system. With this system of trussing in which there are no joints, the compressive members being continuous, and because of the multiple diagonal system of bracing at any point, it is evident that two or three compressive or tensile members may be broken or removed without destroying the safety of the system as a whole. Two curved pieces 7 and two base rails 8 with spreaders 9 and ties 10 to restrain them from moving outward complete the main frame upon which the cloth is stretched, covering the sides and top, the latter forming the main plane of the machine. This plane slopes backward and downward toward the rear of the machine where in the preferred form it makes an angle with the horizontal plane the tangent of which is substantially equal to the quotient obtained by dividing twice the distance the air is forced downward by the distance in which this deflection is accomplished. In other words if L is the horizontal length of the plane and H the height of the point of entrance above that of discharge

$$\frac{2H}{L}$$

will be, approximately, the tangent of the angle which the plane at its lowest point makes with the base line of the machine. One of the objects of this increase in deflection at the back of the plane is to secure a vertical pressure at the back of the plane equal to that at the front of the plane, which has not been accomplished in planes as heretofore constructed.

That a plane of parabolic curvature increasing in sharpness to the rear will cause a uniform pressure I have found out by experiment and it is evident theoretically when we consider a parabola to be the result of a longitudinal uniform velocity and a transverse uniformly accelerated motion. A plane of this shape having air passing under it at a uniform velocity will therefore deflect the air downward with a uniformly accelerated motion, but uniformly accelerated motion can only result from uniform pressure in the direction of the accel-

eration. A uniform vertical pressure therefore results from front to back of such a plane. One of the advantages of this is that with uniform areas the machine will
 5 balance on its middle point. Another advantage of this uniform pressure consists in increase of efficiency for any given area of plane since equal areas are doing equal work in sustaining the machine. Another advantage
 10 is that in case the machine stops its forward motion, the balance is not impaired, while if it runs backward the center of support shifts to near the back of the plane and the reaction of the supporting force acting
 15 at this point in combination with the weight of the machine acting at the center of gravity located near the middle of the machine creates a powerful couple which revolves the machine until forward motion again results.
 20 Hence it is evident that an aeroplane of this design constructed in such a manner that its center of gravity lies underneath the center of support and in the center of the machine will automatically maintain itself
 25 in stable equilibrium. Such a construction is therefore followed in my preferred form.

In establishing the center of gravity underneath the center of support the motor may be located if desired to one side of it
 30 and the seat for the aviator on the opposite side. Or the motor may be located toward the forward end of the machine and the aviator's seat correspondingly to the rear, the object of such a distribution of weights
 35 being to create a moment of inertia tending to prevent a sudden rotation of the machine. The tank for supplying the motor with fuel, being a variable load, is preferably located near the center of support. Suitable connections from the motor revolve outwardly
 40 at the top in opposite directions the two propellers 17 employed in my preferred form, although one may be used. Near the front and on opposite sides of the machine, receiving
 45 a portion of the blast of the propellers are located the controlling planes 11. These planes partially rotate upon axes 12 secured by suitable bearings on the side rails 6 and at 13 on the lower chords of the
 50 trusses, 1^a and 1^b.

For the purpose of enabling the operator to control these planes 11, by hand, the following mechanism is provided: A hand lever
 55 14, is fulcrumed at the rear and about the center of a swinging frame 14^a in such a way that the hand lever 14 may swing about its fulcrum in a direction transverse to the longitudinal axis of the machine. The
 60 swinging frame 14^a is mounted on an axis 14^b transverse to the length of the machine, which allows the upper end of the frame to be moved back and forth in the direction of the length of the machine, the lower end moving in the corresponding opposite direction.
 65 The frame 14^a is provided with four

guiding devices, in the present instance indicated as merely holes in the corners of the frame. The hand lever 14 is connected by suitable tensile connections to the two controlling planes, this being done in the present
 70 embodiment of my invention by cords A, B, C and D, running from the respective upper corners of the controlling planes 11, around corresponding pulleys, *a*, *b*, *c* and *d*, through the holes in the corners of the frame
 75 14^a and thence to the hand lever 14, as will be clear from Fig. 3.

It will be obvious that by swinging the upper end of the frame forward, by pressure in a forward direction on the hand
 80 lever 14, the lower cords B and D will be pulled and the upper cords A and C will be relaxed, whereby the controlling planes 11, will be rotated on their axes to lower the front edges of the planes and raise the rear
 85 edges, thus tending to force the front end of the machine downward. When the frame is swung in the reverse direction, the cords A and C are pulled and the cords B and D relaxed, thus rotating the controlling
 90 planes in the opposite manner and tending to lift the front end of the machine or drive it upward.

By swinging the hand lever 14 from side to side, without moving the frame 14^a on
 95 its axis, the controlling planes are rotated in respectively opposite directions, so that one plane will tend to elevate its side of the machine, while the other plane will tend to depress its side of the machine, whereby
 100 the whole machine tends to rotate on its longitudinal axis. This is useful in turning a curve in the direction of flight and also to right the machine when it accidentally turns on its longitudinal axis. The direction
 105 of the turning produced by the controlling planes depends upon the direction in which the upper end of the hand lever 14 is swung.

The vertical trusses of the machine may
 110 be covered on one or both sides with cloth 1^c to diminish the friction of the air passing along them. The center one in particular is so covered in the preferred form of the machine to lessen the friction and resistance
 115 caused by the tank and machinery, and this covering may be arranged to prevent the blast from striking the aviator and passengers.

A safety device 15 is provided at the top
 120 of the main plane, this consisting in the preferred form of a plurality of planes arranged to extend upward when in their operative position, and attached longitudinally and transversely with reference to
 125 the motion of the machine to the main plane substantially above the center of gravity of the machine, so as to be capable of being elevated to vertical positions or folded down upon the machine. A suitable gaff 16 or
 130

other means pivoted to the frame of the machine holds the planes in operative position and serves to elevate them and collapse them to a position parallel with the main plane, such change being effected manually in my preferred form, when desired and automatically in case the machine should attempt to fall backward. The machine may be provided with runners 18 or other checking devices as used in similar machines for lessening the shock when coming to the ground.

To attain flight with my aeroplane the motor is started. This rotating the propellers increases the air-pressure underneath the main plane, which, while the machine rests on the ground would be static and greatly in excess of that necessary to raise it. For example, if the weight of the machine were not more than two pounds per square foot of plane area and if the velocity and pitch of the propellers were such as to impart to the air passing through them a velocity of forty miles per hour it is evident from a simple calculation employing data familiar to those skilled in the art that if the machine sat on smooth ground allowing no escape of air that the resulting pressure would be more than three times the amount required to lift the machine off the ground. This effect would therefore result and it is equally evident and demonstrable that the machine would then be raised to some additional height above the ground by the direct effect of the propellers' blast acting upon the plane and enhanced by the reaction caused by the checking of its velocity upon impact with the ground and undisturbed air and while making its escape in a restricted area under the plane. In this position resting solely on air there would be not opposition to its forward motion save drift and friction which together would not equal the thrust of the propellers. The machine would therefore immediately begin free flight. To cause the machine to incline upward while in an aerially sustained position the lever 14 is moved backward, although by suitably changing the connections from the preferred manner as shown the movements would be reversed. This causes the controlling planes 11 to deflect downward the air forced against them by the propellers and produces an upward resultant which raises the head of the machine. Moving the lever forward reverses the position of the planes and inclines the machine downward. To produce transverse rotation of the plane the lever is moved in the desired direction which sets the controlling planes at opposite angles and inclines the machine as desired. To turn the machine about a vertical axis the lever is moved in the direction in which it is desired to turn and also backward. The result of this is to set

in substantially the normal position the plane located on the side toward which the turn is to be made and to set the opposite plane in position to produce inward transverse thrust upon the head of the machine thus turning it about as desired. This inward thrust is increased because of the lifting up of that side of the machine on which is located the plane producing this thrust which causes the axis of this auxiliary plane to more nearly approach a vertical position. This lifting effect also tends to neutralize loss of height due to loss of velocity. The object of placing the controlling device in the propellers' blast is to enable the machine to be revolved about either of its axes while slightly raised above the ground and without the aid of a forward motion. This permits the aviator to have control of the machine from the start. It also permits a novice in the art to acquire near the ground the necessary practice required to successfully operate such a machine in free flight, because by anchoring the machine with a cable 19 which the machine may carry attached to it by a controllably yielding connection 20, Fig. 5, or by the employment of any other suitable means that would prevent horizontal motion the machine may be raised from the ground and held afloat although stationary. In case of accident to any part of the machine causing impairment of stability or control the motor may be stopped and the safety device brought into operative position by revolving the gaff to a vertical position. This checks rotation in every direction and if permitted to incline backward suitably, allows the machine to run forward at any desired speed, gliding to the ground.

Having thus described my invention I claim as new and desire to secure by Letters Patent:

1. In an aeroplane, the combination, with a power-driven propeller, of a plane curving rearwardly and comprising a substantially continuous surface extending backward and downward and arranged to react against substantially the propeller's entire blast.

2. In an aeroplane, the combination, with a power-driven propeller, of a plane curving rearwardly and comprising a substantially continuous surface extending backward and downward and arranged to react against substantially the propeller's entire blast, said reacting surface terminating near the base line of the machine.

3. In an aeroplane, the combination, with a power-driven propeller, of a plane comprising a substantially continuous surface extending backward and downward and arranged to react against substantially the propeller's entire blast, the rear portion making an angle with the base of the ma-

chine the tangent of which is substantially equal to the quotient obtained by dividing twice the height of the point of blast entrance above that of discharge, by the horizontal length of the plane.

4. In an aeroplane, the combination, with a power-driven propeller, of a plane comprising a substantially continuous surface extending backward and downward and arranged to react against substantially the propeller's entire blast, said plane being formed as a parabolic surface which increases in degree of curvature to the rear.

5. In an aeroplane, the combination, with a motor-driven propeller, of a longitudinally curved plane wholly to the rear of the propeller and arranged to resist the escape of substantially the entire blast of the propeller in every direction save toward the earth, the height of said plane decreasing toward the rear of the machine.

6. In an aeroplane, the combination, with a motor-driven propeller, of a longitudinally curved plane wholly to the rear of the propeller and arranged to resist the escape of substantially the entire blast of the propeller in every direction save toward the earth, said plane terminating near the base of the machine, the height of said plane decreasing toward the rear of the machine.

7. In an aeroplane, the combination, with a motor-driven propeller, of a plane wholly to the rear of the propeller and arranged to resist the escape of substantially the entire blast of the propeller in every direction save toward the earth, said plane terminating near the base of the machine in substantially a horizontal plane, the height of said plane decreasing toward the rear of the machine.

8. In an aeroplane, the combination with motor-driven propellers and a substantially continuous main plane sloping backward and downward and arranged to react against substantially the propellers' entire blast, of a movable controlling plane covered by the main plane and located in such blast at a distance from the center of the machine.

9. In an aeroplane, the combination with motor-driven propellers and a substantially continuous main plane sloping backward and downward and arranged to react against substantially the entire blast of the propellers, of a plurality of movable controlling planes carried by the main plane and located in such blast at a distance from each other and from the center of gravity of the machine.

10. In an aeroplane, the combination, with a motor-driven propeller and a load-sustaining main plane, arranged in the path of and adapted to react against substantially the entire blast of the propeller, of movable controlling planes carried by the main plane and located at a distance from the

longitudinal transverse and vertical axes passing substantially through the center of gravity of the machine.

11. The combination, with a power-driven propeller, and a load-sustaining main plane, 70 arranged in the path of and adapted to react against substantially the entire blast of the propeller, of movable auxiliary controlling planes located at a distance from each other and from the longitudinal transverse 75 and vertical axes through the center of gravity of the machine and normally lying in imaginary planes intersecting in a line parallel with the air-currents passing said controlling planes.

12. In an aeroplane, the combination, with a motor-driven propeller and load-sustaining main plane, of a safety device consisting of vertically extensible longitudinal and transverse planes, intersecting each other, 85 movably attached to the main plane substantially above the center of gravity, and normally lying parallel to and above it, and means for operating said planes.

13. In an aeroplane, the combination, with a motor-driven propeller and a load-sustaining main plane, arranged in the path of and adapted to react against substantially the entire blast of the propeller, substantially covering the entire blast of the propeller, of means for checking horizontal motion of the machine while it is aerially sustained above the ground.

14. In an aeroplane, the combination, with a pair of motor-driven propellers and a load-sustaining main plane arranged in the path of and adapted to react against substantially the entire blast of the propeller, substantially covering the entire blast of the propeller, of a vertical plane located underneath and attached to said plane, and dividing the blast from the two propellers.

15. An aeroplane comprising a main plane sloping downwardly to the rear substantially to the imaginary base plane of the apparatus, said main plane having lateral extensions substantially continuous therewith extending downwardly substantially to said base plane, and a power-driven propeller located in front of said main plane 115 and arranged to deliver substantially its entire blast thereagainst.

16. An aeroplane comprising a supporting plane of substantially parabolic curvature increasing in sharpness toward the rear, 120 said plane having lateral downwardly extending portions whose lower edges are substantially coplanar with the rear edges of said plane, said plane with its extensions forming a substantially continuous reaction surface or structure enclosed except as to its front and bottom, and a power-driven propeller arranged to deliver blast into the front of said structure.

17. In an aeroplane, the combination with 130

a power-driven propeller, of a plane comprising a substantially continuous surface curving backward and downward, the upper forward end of said plane extending above, 5 and the lower rear end of the plane extending below, the blast of said propeller.

18. In an aeroplane, the combination with a power-driven propeller arranged at the front of the machine, of a supporting plane 10 having a concave under surface and extending rearwardly and downwardly in a sub-

stantially parabolic curve from a point at the front above the blast of the propeller to a point at the back below the blast of the propeller.

In testimony whereof, I affix my signature 15 in the presence of witnesses.

WILLARD S. ISHAM.

Witnesses:

M. C. MASSIE,
M. V. LOWE.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."