W. W. CHRISTMAS.

FLYING MACHINE.

APPLICATION FILED OCT. 30, 1909.

957,744.

Patented May 10, 1910.

4 SHEETS—SHEET 1.

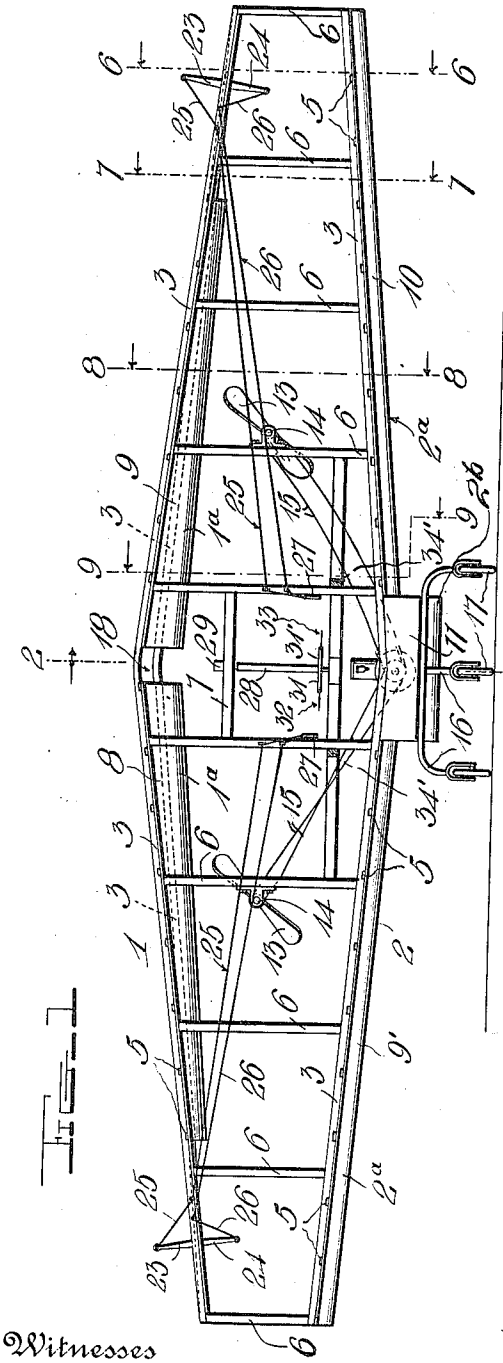

FIG. 1

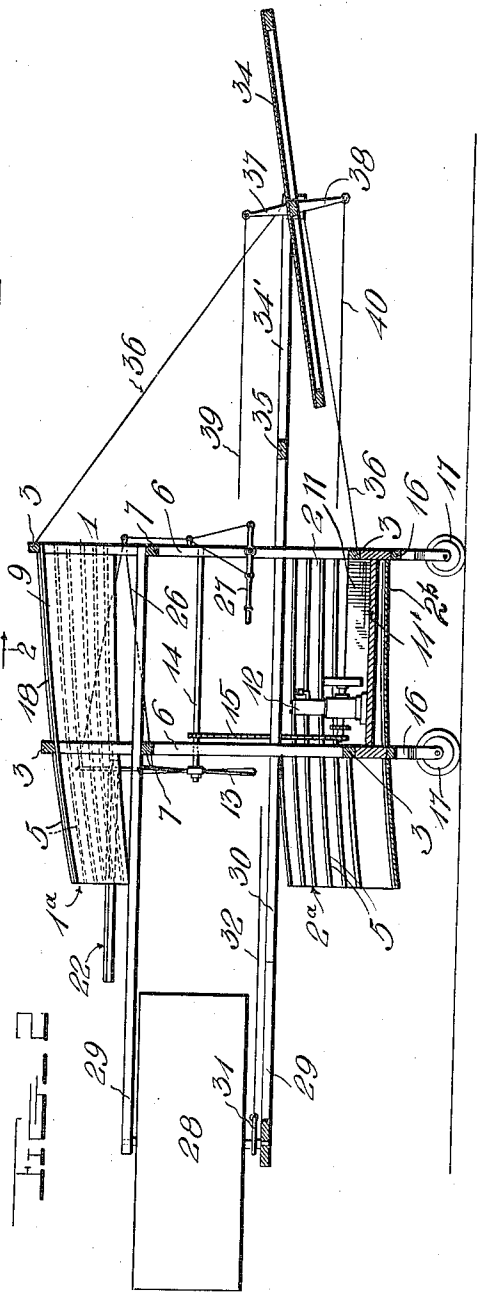

FIG. 2

Witnesses

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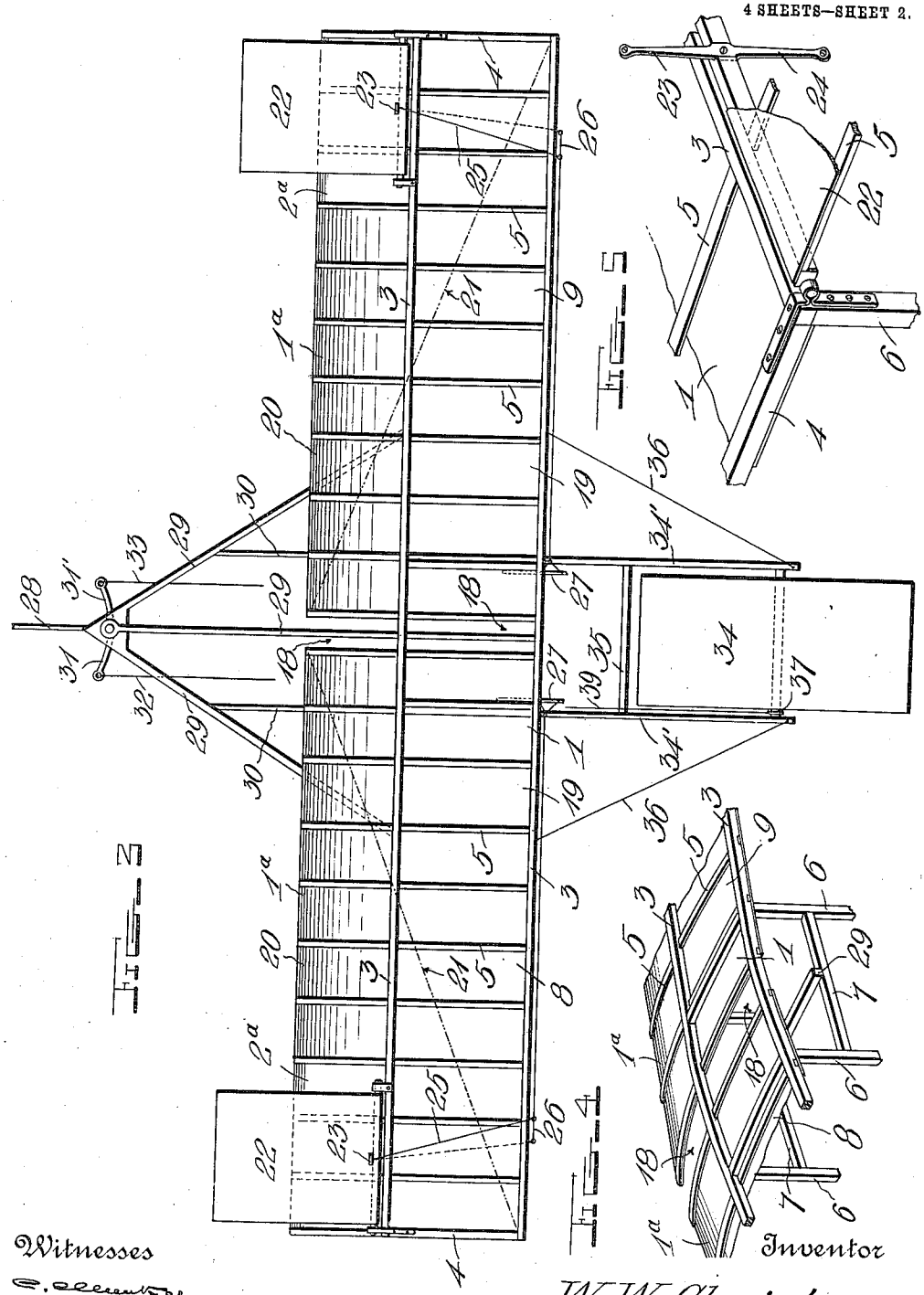
4 SHEETS—SHEET 2.



Witnesses

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4 SHEETS—SHEET 3.

FIG. 7

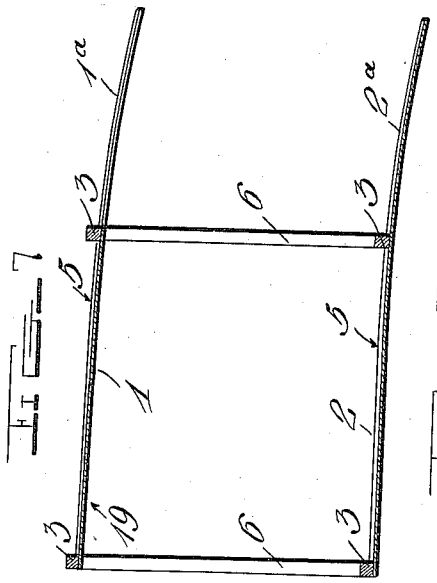


FIG. 9

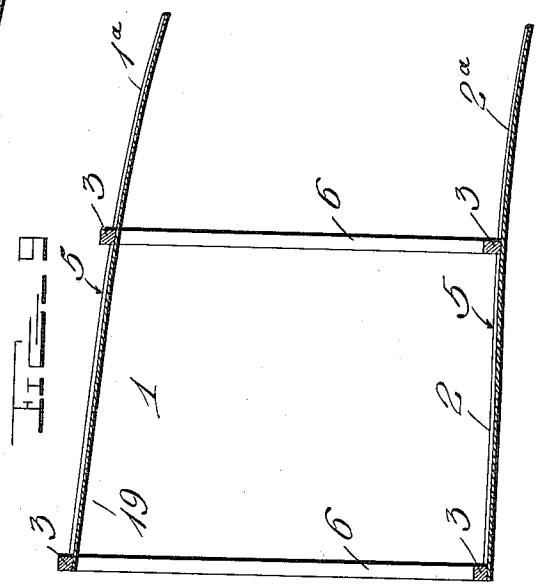


FIG. 6

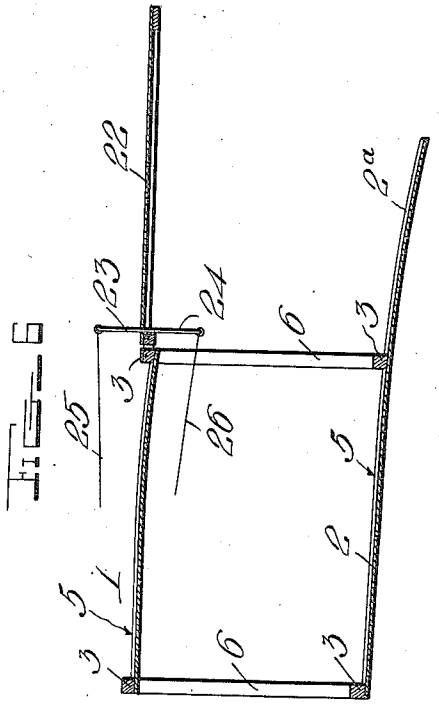
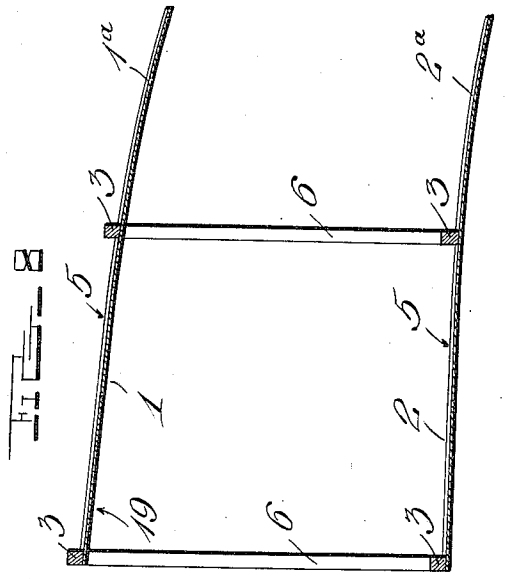


FIG. 8



Witnesses

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4 SHEETS—SHEET 4.

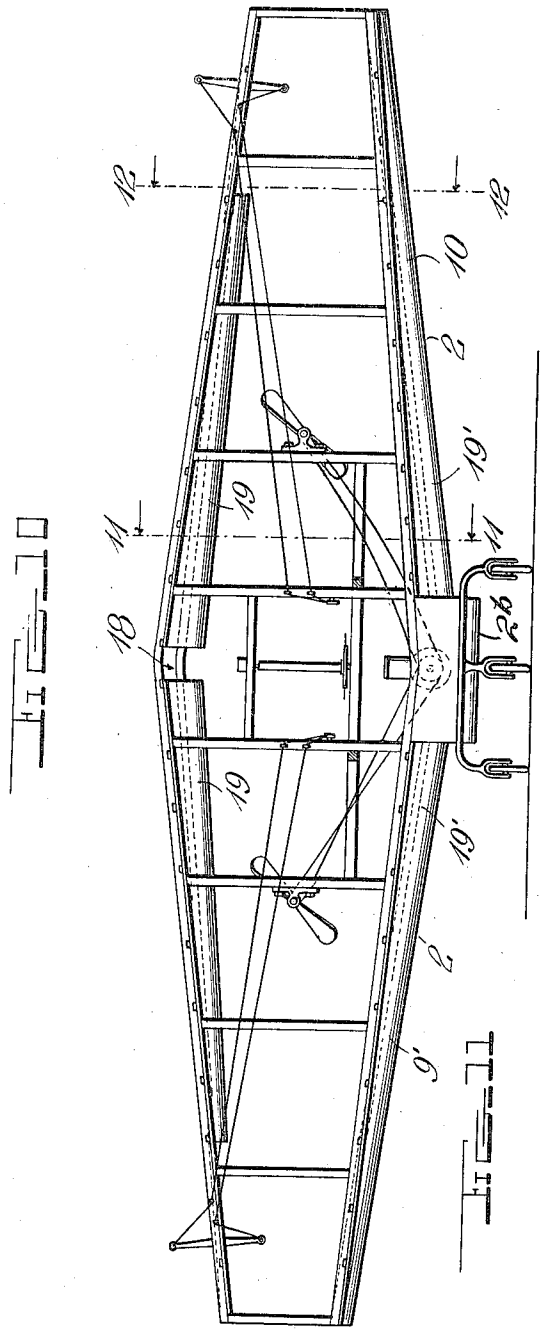

FIG. 10

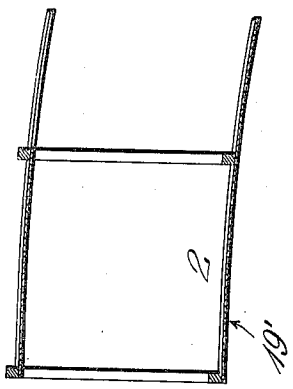

FIG. 12

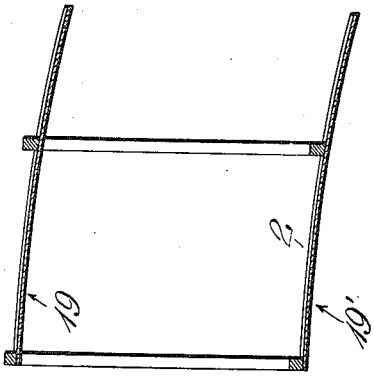

FIG. 11

Witnesses

C. [illegible]

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UNITED STATES PATENT OFFICE.

WILLIAM W. CHRISTMAS, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR OF FORTY-NINE ONE-HUNDREDTHS TO CREED M. FULTON AND THOMAS W. BUCKEY, BOTH OF WASHINGTON, DISTRICT OF COLUMBIA, AND LESTER C. McLEOD, OF ASTORIA, OREGON.

FLYING-MACHINE.

957,744. Specification of Letters Patent. Patented May 10, 1910.

Application filed October 30, 1909. Serial No. 525,497.

To all whom it may concern:

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

My invention relates to flying machines of the aeroplane type.

The primary object of the invention is to provide a machine which will be self-balancing or maintain an automatic equilibrium under any and all normal conditions in flight.

A further object of the invention is to provide a machine which in the event of accident to its motor or propelling means, or reduction of its speed below the sustentation speed limit from any other cause, will preserve its center of gravity and descend easily to the ground.

A still further object of the invention is to provide a machine which diminishes the resistance to flight and hence may be driven at a greater rate of speed than prior machines of the same size and equipped with a motor of corresponding driving power.

With these and other objects in view, the invention consists of the features of construction, combination and arrangement of parts hereinafter fully described and claimed, reference being had to the accompanying drawings, in which:—

Figure 1 is a front elevation partially broken away, of a flying machine embodying one form of my invention. Fig. 2 is a central vertical fore and aft section on line 2—2 of Fig. 1. Fig. 3 is a top plan view of the machine. Fig. 4 is a perspective view of the central portion of the upper aeroplane. Fig. 5 is a perspective view of one of the rear corners of the upper aeroplane showing the mode of mounting the adjacent leveling plane. Figs. 6, 7, 8 and 9 are fore and aft sections on the lines 6—6, 7—7, 8—8, and 9—9 of Fig. 1. Fig. 10 is a front elevation illustrating a modification in the construction of the machine. Fig. 11 is a fore and aft section on line 11—11 of Fig. 10. Fig. 12 is a similar section on line 12—12 of Fig. 10.

In the preferred form of the invention herein disclosed, the machine is shown as comprising two superposed aeroplanes 1 and 2, providing a machine of the so-called "biplane" type, which construction is preferred, although features of the invention may be employed in a structure employing a single aeroplane or more than two aeroplanes. Each aeroplane extends lengthwise in a direction transversely of the machine or to the line of flight and is composed of a suitable fabric stretched over and secured to a frame comprising a pair of parallel longitudinal bars 3, extending from side to side of the machine, end bars 4 connecting the terminal portions of said longitudinal bars, and cross strips or battens 5 arranged in parallel relation to the end bars and connecting and bracing the longitudinal bars to form a strong and rigid frame structure.

Preferably the two planes are correspondingly concavo-convexly curved or dished to a desired extent between their front and rear edges with their concaved surfaces facing downwardly, as usual, to promote the buoying action of the currents of air thereon, but this form of the planes is not absolutely essential. When the two planes are employed, as described, they are connected by standards or upright bars 6 spaced apart around the machine and rigidly united at suitable intervals to the frame bars 3 and 4. Braces 7 connect the adjacent front and rear standards located immediately on opposite sides of the center of the machine to further strengthen the structure at this point and form supports for elements of the propelling and steering devices, as hereinafter described. In addition to these parts any preferred construction and arrangement of bracing connections may be used to increase the strength and durability of the machine, as may be found desirable or circumstances may require.

The two aeroplanes instead of being straight and parallel throughout their length, as in ordinary constructions, are in

general of concavo-convex form lengthwise or transversely to the line of flight with their concaved surfaces facing each other—that is to say, said aeroplanes converge from an intermediate point at the vertical fore and aft center of the machine toward their respective ends, the latter, however, being spaced a proper distance apart for the free passage of air. For convenience of description and purpose of more clearly specifying the novel and characteristic features of the invention, each plane may be considered as being centrally divided from front to rear into counterpart plane sections, the sections or transverse portions 8 and 9 of the upper plane 1 inclining outwardly and downwardly at a desired angle from their inner or proximate ends, while the sections or transverse portions 9′ and 10 of the lower plane 2 correspondingly incline outwardly and upwardly. While the planes are, as stated, in general of concavo-convex form with their concaved surfaces facing each other, it will be noted that they are devoid of a true longitudinal curvature, the sections or transverse portions of each plane extending on straight lines at a diahedral angle from the center to the lateral margins of each plane. The reason for this peculiar construction and relative arrangement of the aeroplanes is to secure, in connection with other features, counterbalancing actions of the currents of air to steady the machine in flight and to adapt it to automatically maintain its center of gravity or equilibrium, as will fully appear in the subjoined statement of the principle of operation of the machine.

The lower plane 2 has a downwardly jogged or offset portion 2^b connecting the proximate inner ends of its sections or wings 9′ and 10, and which extends vertically along the opposite sides of and horizontally beneath a boxlike car or body 11. This car or body extends fore and aft between and is secured to the longitudinal frame bars of said plane and has an elevated bottom 11′, forming a support for the driving motor 12, which may be of any suitable type. In front of this motor, either on the bed or front longitudinal frame bar of the plane 2, the aviator's seat (not shown) is preferably arranged, the parts being so disposed as to make the center of gravity of the machine as low as possible and to equalize and balance the supported weights as much as possible at this point when the aviator is seated. In practice the machine may be driven by one or more propellers, a pair of vertically disposed rotary propellers 13 being shown in the present instance. These propellers are mounted in rear of the frame structure, at opposite sides of the medial fore and aft line of the machine, on horizontal shafts 14 journaled in suitable bearings on alined front and rear pairs of the standards 6, and are driven in reverse directions by belts or chains 15 or other suitable gearing from the motor shaft, the blades of said propellers being properly pitched or inclined to drive the machine forwardly. I may, however, arrange and mount the propellers in any other desired manner as may be found most serviceable under varying conditions. Brackets 16 may be secured to the bed or adjacent parts of the frame structure and carry ground wheels or rollers 17 to enable the machine to be conveniently transported from place to place along the surface of the ground or to serve as traction devices on which the machine may run in starting it in flight from the ground surface.

In the embodiment of my invention disclosed in Figs. 1 to 9, inclusive, the lower plane 2 is preferably either flat or has a desired degree of outward and downward curvature between its front and rear edges so as to present an angle of incidence and confine or retard the currents of air impinging against its under surface to secure the desired buoying effect. The extent of flotation surface presented by each plane is increased by prolonging or projecting the body portions of both planes 1 and 2 rearwardly in the form of longitudinal wings or extensions 1^a and 2^a, respectively, preferably constructed by continuations of the fabric and battens or cross strips 5 composing the plane structures. These wings or extensions prolong the arc of curvature of the planes to confine or retard the impinging currents of air only to the necessary extent. As, however, the air is liable under some atmospheric conditions to accumulate beneath the planes faster than it is shed by the plane surfaces, causing the production of eddying currents which tend to inhibit a buoying action and offer an increased resistance to the propulsion of the machine, I construct the wings or rear portions of the planes so that they may act under such conditions to free the air with greater rapidity. To this end, the fabric of the wings is fastened only to the rear extensions of the strips or battens 5, which are somewhat flexible and left free or unconnected at their outer or rear ends, whereby the rear portions or edges of the wings are adapted to flutter or vibrate or to bend upwardly, according to the volume and pressure of the confined air, allowing the latter to escape beneath said edges, which, on the escape of the portions of air, return by their own resiliency to normal position. As a result, the retention of an excess volume or pressure of air beneath the planes will be prevented, greater safety against gusts acting too violently on the planes insured, and liability of an undue resistance to the propulsion of the machine obviated. In this respect and capability of operation the

wings simulate the air shedding action of the edges of the wings of a bird and perform the same functions under like conditions. The wings of the upper plane are somewhat shorter than the sections of said plane to leave spaces in rear of the outer terminals of the plane sections for the accommodation of the leveling planes, hereinafter described, while the wings of the lower plane may accord in length and arrangement with the upper plane wings or extend the full length of the lower plane sections, as desired.

The upper plane 1 is of materially different construction, otherwise than heretofore stated, from those heretofore in use. As shown, this plane is transversely divided at the center or has the proximate edges of its sections 8 and 9 spaced to provide a fore and aft air gap, vent or passage 18 extending the full distance from its front frame bar 3 to the rear edges of the wings 1^a. For convenience of description, each plane section may also be considered as divided into imaginary triangular front and rear portions 19 and 20 on planes indicated by the dotted lines 21 shown in Fig. 3 extending from the outer front corners of said sections to the inner rear corners of the wings 1^a. The triangular rear portions 20 and wings 2^a of the plane sections have the simple cross-sectional curvature heretofore described, so that the currents of air impinging against their under surfaces will be confined and retarded sufficiently for a buoying action thereon and will at the same time, through their action on the diahedrally inclined wings, tend to exert an upward tilting pressure on lines converging inwardly and forwardly toward the center of the machine, thereby steadying the machine and opposing a certain resistance to both a fore and aft and a lateral tilting motion of the machine as a whole. The triangular front portion 19 of each plane section, on the contrary, in addition to having such transverse curvature, is also warped at an angle to the remainder of the plane section in such a manner as to incline both upwardly and forwardly from the dotted line 21 to the front edge of said section and upwardly and inwardly from the outer front corner of said section to the air gap or passage 18, the degree of inclination or slope gradually and progressively increasing, the highest points of the slope of the warped portions of the plane sections being at the front edges of said plane sections and marginal edges of the air gap. A convenient way of warping each plane section is to incline the front longitudial bar 3 thereof inwardly and upwardly at a greater angle than the rear longitudinal bar 3 thereof, as clearly illustrated in Fig. 1, by simply extending the front stanchions 6, beginning with the next to the outermost one of the series, progressively to gradually increasing elevations above the horizontal lines of the upper ends of the companion rear stanchions 6. The portion 19 of the plane section in advance of the dotted line 21 will accordingly be raised for the greater portion of its length above the general level of the portion 20 of the plane section in rear of said dotted line, and will accordingly incline at a greater angle to the general diahedral line of the plane section than said rear portion both upwardly and forwardly toward the front edge of said plane section and also upwardly and inwardly toward the gap. The degree of helical warp or inclination of the portions 19 thus produced may be, and preferably is, just sufficient to present guiding or conducting surfaces to cause a certain portion of the air impinging against the surfaces of the plane in the progress of the machine to flow diagonally inward and rearward across the plane and vent through the gap 18, while the remainder of the air passes across the surfaces of the plane from front to rear thereof. By the described construction of the plane 1 several important results are obtained, as follows: The air striking against the front edge of the plane, instead of banking and forming an air cushion against such edge and causing the machine to tilt upwardly and rearwardly, whereby its fore and aft balance is liable to be destroyed, is divided in its flow, a sufficient portion for sustentation purposes passing from front to rear across the surface of the plane, while another portion passes directly to the gap and discharges upwardly therethrough. Hence the fore and aft balance will be preserved, while any excess amount of air, liable otherwise to accumulate beneath the plane and offer a resistance to propulsion, will be carried off. Through the described reactions of the air on the plane surfaces, a parachutic action will also be established, allowing excess pressure from gusts of large volume to escape, while promoting buoyancy, with an increased degree of safety in the operation of the machine. Furthermore, the diagonally flowing currents of air more effectually distribute the pressure of the air on the surfaces of the plane, preventing, to a large extent, any such variations of pressures as would be liable to destroy either the fore and after or lateral balance or equilibrium of the machine and cause it to turn over. As such pressures are mainly toward the center of the machine, the action of the air currents will tend, rather than otherwise, to maintain the established center of gravity, making the machine self-balancing under all normal conditions.

It will thus be apparent that when the machine is in flight the planes will travel

substantially horizontally or edgewise, presenting only the required angle of incidence to sustain the machine when traveling at or above sustentation speed. As the broad-side surfaces lying at an angle to the line of flight will thus be diminished over machines which tend to tilt upwardly and rearwardly and travel on an inclined plane, increased speed may obviously be obtained. The currents of air striking the outwardly and upwardly diahedrally inclined sections of the lower plane 2 travel outwardly and rearwardly, thus buoying and balancing the machine at its sides and opposing the overbalancing tendencies of cross currents within and beyond the lateral margins of the machine, while the currents of air striking the correspondingly outwardly and downwardly inclined sections of the upper plane travel inwardly and rearwardly to balance and buoy the machine at the center, the diverse diagonal currents acting on the two planes serving to produce a state or condition of the surrounding atmosphere which prevents gusts or large volumes of approaching air from exerting their forces on the machines until such forces are calmed or diminished in intensity. Under all normal conditions, therefore, the machine will be self-balancing and maintain its poise or state of equilibrium in flight. If, from any cause, the motive power should fail and the forward motion of the machine be arrested, or the speed of motion be reduced to a point below the required sustentation speed, the parachutic effect of action of the upper areoplane and the described action of the air upon the surfaces of both planes will cause the machine to simply rotate slowly on its axis and descend gradually to the ground, thus insuring the safety of the machine and its occupant under all ordinary conditions. This follows from the peculiar construction of the upper plane and the fact that the rear wing extensions and inclined diagonal air guiding surfaces of said plane in effect form propeller blades against which the air may strike to rotate the machine in one direction or the other, according to the location of the propeller surface first acted upon when the machine is not positively driven forward at sustentation speed, but which neutralize each other when the machine is driven forward at sustentation speed to prevent deflection of the machine from a straight course. By inclining the sections of each plane on straight lines between the center of the plane and the lateral margins of said sections, the air is prevented from rebounding, as is the case in the use of curved surfaces, and forming currents of air between the planes which, by their undue reaction against each other and the compression surfaces of the planes, increase the resistance to the propulsion of the machine and inhibit a free air shedding action. Moreover, the air striking against the straight inclined surfaces slides more freely along the same, thus allowing the air to freely shift in the manner before described to secure the balancing pressures upon the surfaces of the planes.

In order, however, to enable the machine to be balanced and controlled under other than normal conditions, as when the machine encounters very strong winds, I provide vertically movable leveling planes or wings 22 pivoted to swing vertically on horizontal axes upon the rear longitudinal bars 3 of the plane 1 beyond the outer lateral extremities of the wings 1^a. Each of these leveling planes or wings is provided with upwardly and downwardly extending lever arms 23 and 24 connected respectively with ropes or cords 25 and 26 extending over suitable guides to a pivoted controlling lever 27 arranged adjacent to the aviator's seat, said cords being connected to the lever on opposite sides of its pivotal point, whereby through reverse movements of the lever the plane may be swung up or down to different angular positions, so that by elevating one wing and depressing the other any tendency of the machine to tilt unduly may be overcome. For the purpose of laterally steering the machine a rudder plane 28 is mounted to swing on a vertical axis journaled on supporting bars 29 extending rearwardly from the center of the machine frame and stayed by suitable braces 30. Extending oppositely from the shaft or axis of this rudder plane are lateral lever arms 31 and 31′ to which ropes or cords 32 and 33 are respectively connected. These ropes or cords lead in practice to suitable operating means (not shown) by which the rudder may be turned to the right or left to laterally vary the line of flight. A rudder plane 34 is also provided to steer the machine vertically and is mounted to swing on a horizontal axis supported by bars 34′ extending forwardly from the center of the machine frame and braced by a connecting bar 35 and by guys 36 extending from the machine frame or in any other suitable manner. The shaft or axis of this rudder plane is provided with upwardly and downwardly extending lever arms 37 and 38 from which respectively lead ropes or cords 39 and 40 to suitable operating means (not shown) whereby said rudder plane may be turned to different angles to cause the machine to ascend and descend, as will be readily understood. While I have described and shown leveling planes and rudders of a certain style and arrangement, I do not wish to be limited thereto, as any other suitable style and arrangement may be employed.

In the modified form of my invention shown in Figs. 10, 11, and 12, the lower

aeroplane 2 is identical in construction with the upper aeroplane with the exception of the formation of the air gap 18 and shortening of the wings 2^a, said lower plane being provided with warped portions 19′ corresponding in form and arrangement with the warped portions 19 of the upper plane. Owing to the outward and upward inclination of the plane sections 9′ and 10, however, these warped portions 19′ guide and conduct the currents of air outwardly and rearwardly toward the lateral margins of said plane sections instead of inwardly and rearwardly toward a central gap. As a result, a portion of the air striking the lower plane sections flows across the same from front to rear, while the remainder of the air flows diagonally outwardly along the front triangular portions of the plane sections toward the lateral margins thereof. Hence the air while buoying the lower plane throughout its length will act to a larger extent upon its marginal portions to transfer the main points of suspension thereto, while the reverse currents acting upon the upper plane will make the main point of suspension thereof at the center, thus equalizing and balancing the pressures to secure increased stability. This form of the invention is deemed preferable for comparatively heavy machines requiring the use of a maximum amount of pressure equalizing or balancing surfaces.

Having thus described my invention I claim:—

1. In a flying machine, the combination of a plurality of separate, independent, suitably spaced supporting planes of concavo-convex form in the direction of their length transversely of the line of flight, and means uniting said supporting planes with their concave sides toward each other.

2. In a flying machine, the combination of a plurality of separate, independent, superposed, suitably spaced supporting planes, each having a concave and a convex side, the upper supporting plane having an intermediate air gap, and means uniting said supporting planes with their concave sides toward each other.

3. In a flying machine, the combination of a plurality of separate, independent, superposed, suitably spaced supporting planes, each having a concave and a convex side, the upper supporting plane having also an intermediate air gap and warped to present air guiding surfaces leading to said gap, and means uniting said supporting planes with their concave sides toward each other.

4. In a flying machine, the combination of a plurality of separate, independent, superposed, suitably spaced supporting planes, each having a concave and a convex side, the upper supporting plane also having an intermediate fore and aft air gap and warped to present inclined air guiding surface converging and increasing in area toward the gap, and means uniting said supporting planes with their concave sides toward each other.

5. In a flying machine, the combination of a plurality of separate, independent, superposed, suitably spaced supporting planes, each having a concave and a convex side, the upper supporting plane also having an intermediate fore and aft air gap and warped to present inclined air guiding surfaces arranged on opposite sides of said gap and converging and increasing in area from the lateral margins of said supporting plane toward the gap, and means uniting said supporting planes with their concave sides toward each other.

6. In a flying machine, the combination of a plurality of separate, independent, superposed, suitably spaced supporting planes, each having a concave side and a convex side, the lower supporting plane being continuous between its lateral margins and the upper supporting surface being provided with a central air gap and warped to present air guiding surfaces on opposite sides of and leading to said gap, and means uniting said supporting planes with their concave sides toward each other.

7. In a flying machine, a plurality of separate, independent, superposed, suitably spaced supporting planes, each having a concave and a convex side, the lower supporting plane being continuous from end to end and the upper supporting plane transversely divided by an air gap intermediate its ends, and means uniting said supporting planes with their concave sides toward each other.

8. In a flying machine, a plurality of separate, independent, superposed, supporting planes, the lower supporting plane having transverse portions inclining at a suitable angle outwardly and upwardly from its center and the upper supporting plane having transverse portions inclining at a suitable angle outwardly and downwardly from its center, and means connecting and holding said supporting planes in spaced relation.

9. In a flying machine, a plurality of separate, independent, superposed supporting planes, the lower supporting plane having transverse portions inclining upwardly and outwardly at a suitable angle from its center and the upper supporting plane having transverse portions inclining outwardly and downwardly at a suitable angle from its center and having a central transverse air gap, and means connecting and holding said supporting planes in spaced relation.

10. In a flying machine, a plurality of separate, independent, superposed, supporting planes, the lower supporting plane having transverse portions inclining upwardly

and outwardly at a suitable angle from its center and the upper supporting plane having transverse portions inclining outwardly and downwardly at a suitable angle from its center and having a central fore and aft air gap and warped portions presenting air guiding surfaces on opposite sides of and leading to said gap, and means connecting and holding said supporting planes in spaced relation.

11. In a flying machine, a plurality of separate, independent, superposed, supporting planes, the lower supporting plane having transverse portions inclining upwardly and outwardly at a suitable angle from its center and the upper supporting plane having transverse portions inclining outwardly and downwardly at a suitable angle from its center and having a central fore and aft air gap and warped portions presenting inclined air guiding surfaces converging and increasing in area toward said gap, and means connecting and holding said supporting planes in spaced relation.

12. In a flying machine, a plurality of separate, independent, superposed suitably spaced supporting planes, the upper supporting plane having its ends inclining at an angle outwardly and downwardly and the lower supporting plane having its ends inclining at a corresponding angle outwardly and upwardly, said upper supporting plane being provided with a central fore and aft air gap and warped portions forming inclined air guiding portions on opposite sides of and leading to the gap, and means connecting and holding said supporting planes in spaced relation.

13. In a flying machine, a lower plane having its transverse portions inclining outwardly and upwardly at an obtuse angle, an upper plane separate from and independent of said lower plane and having its transverse portions inclining outwardly and downwardly at a corresponding angle, and means connecting and holding said planes in spaced relation.

14. In a flying machine, a lower plane having its transverse portions inclining outwardly and upwardly at an obtuse angle, an upper plane separate from and independent of said lower plane and having its transverse portions inclining outwardly and downwardly at a corresponding angle, said transverse portions being spaced at their proximal edges by an intervening air gap, and means connecting and holding said planes in spaced relation.

15. In a flying machine, a lower plane having its transverse portions inclining upwardly and outwardly at an obtuse angle, an upper plane having its transverse portions spaced by a central air gap and inclining downwardly and outwardly at a corresponding angle, said transverse portions being warped to provide inclined diagonal air guiding surfaces leading to the gap, and means connecting and holding said planes in spaced relation.

16. In a flying machine, an aeroplane of concavo-convex form both longitudinally and transversely, and having a fore and aft air gap at the center thereof.

17. In a flying machine, an aeroplane having its transverse portions inclined downwardly and outwardly at an obtuse angle and spaced at their proximal ends by an air gap, said transverse portions being warped to provide inclined air guiding surfaces leading inwardly and rearwardly to said gap.

18. In a flying machine, an aeroplane having its transverse portions inclined downwardly and outwardly at an obtuse angle and spaced at their proximal ends by an air gap, said transverse portions being warped to provide air guiding surfaces progressively increasing in transverse area and inclined upwardly, inwardly and rearwardly from their front corners to the sides of the gap.

19. In a flying machine, an aeroplane of oblong rectangular outline and concavo-convex form both longitudinally and transversely, and provided with a central fore and aft air gap separating it into counterpart sections, each of said sections being warped to provide an inclined triangular air guiding surface extending diagonally from its front corner to the gap.

20. An aeroplane concavo-convexly curved in cross-section and having a fore and aft air gap, said plane having its transverse portions on opposite sides of the gap warped to provide inclined air guiding surfaces converging inwardly and rearwardly toward the gap.

21. A flying machine embodying a plane having supporting portions relatively inclined downwardly and outwardly and spaced at their adjacent edges by an air gap, said supporting portions being of a contour to conduct portions of the air across the plane and portions toward the gap.

22. A flying machine embodying a lower plane having surfaces for directing currents of air rearwardly and toward the lateral margins thereof, and an upper plane having surfaces for directing currents of air rearwardly across the same and toward the center thereof and means for permitting escape of the air at the latter point.

23. An aeroplane provided with a central air gap and surfaces for conducting currents of air inwardly and rearwardly on converging lines from the front portions of the plane to the gap.

24. An aeroplane having a central fore and aft air gap and having its portions on opposite sides of the gap provided with

conducting surfaces for guiding the air inwardly and rearwardly to the gap.

25. An aeroplane provided with a central fore and aft air gap and having its portions on opposite sides of the gap inclined upwardly and inwardly toward the gap on diagonal lines extending from the front corner portions of the plane to the rear corners of the gap.

26. An aeroplane having a fore and aft air gap, separating said plane into counterpart sections, the front portions of said sections providing rearwardly and inwardly inclined surfaces gradually increasing in area from the lateral ends of said sections to the gap.

27. An aeroplane concavo-convexly curved in cross-section and provided with a fore and aft air gap and having its sections on opposite sides of the gap inclined upwardly and inwardly toward the gap on diagonal lines extending from the front corners of the plane to the rear corners of the gap.

28. An aeroplane having a central fore and aft air gap, dividing the plane into counterpart sections on opposite sides of the gap, each section being provided with surfaces for conducting portions of the air respectively across the plane and diagonally to the gap.

29. An aeroplane provided with an air gap and with surfaces for conducting portions of the air respectively across the plane and on inwardly and rearwardly converging lines to the gap.

30. An aeroplane provided with a central fore and aft air gap and having conducting surfaces leading to the gap, the rear edge of the plane being free to vibrate for the ready escape of air.

31. An aeroplane having a fore and aft air gap, the sections of the plane on opposite sides of the gap having air conducting surfaces leading thereto and being provided with rearwardly projecting wings or extensions having vibratory rear edges.

32. A flying machine embodying a lower plane inclined outwardly and upwardly from its center to its lateral margins, and a reversely inclined upper plane, said upper plane being provided with a central air gap and surfaces for conducting portions of the air across said plane and portions toward the gap.

33. A flying machine embodying a lower plane having surfaces for directing currents of air rearwardly and toward the lateral margins thereof, and an upper plane having a central air gap and surfaces for conducting currents of air across the plane and inwardly and rearwardly to the gap.

34. In a flying machine, a lower plane having its transverse portions inclining outwardly and upwardly at an obtuse angle, and an upper plane having its transverse portions inclining outwardly and downwardly at a corresponding angle, said upper plane being provided with an air gap between the proximal edges of its said transverse portions, and the latter being warped to provide guiding surfaces for leading portions of the air toward said gap.

35. In a flying machine, a lower plane having its transverse portions diahedrally inclined outwardly and upwardly, an upper plane separate from and independent of said lower plane and having its transverse portions correspondingly inclined outwardly and downwardly, and means connecting and holding said planes in spaced relation.

36. In a flying machine, a lower plane having its transverse portions diahedrally inclined outwardly and upwardly, an upper plane separate from and independent of said lower plane and having its transverse portions correspondingly inclined outwardly and downwardly, and spaced at their proximal edges by an air gap, and means connecting and holding said planes in spaced relation.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM W. CHRISTMAS.

Witnesses:

B. MAUS,

J. H. CRAWFORD.