C. J. LAKE.

FLYING OR SOARING MACHINE.

APPLICATION FILED AUG. 9, 1909.

1,049,498.

Patented Jan. 7, 1913.

4 SHEETS—SHEET 1.

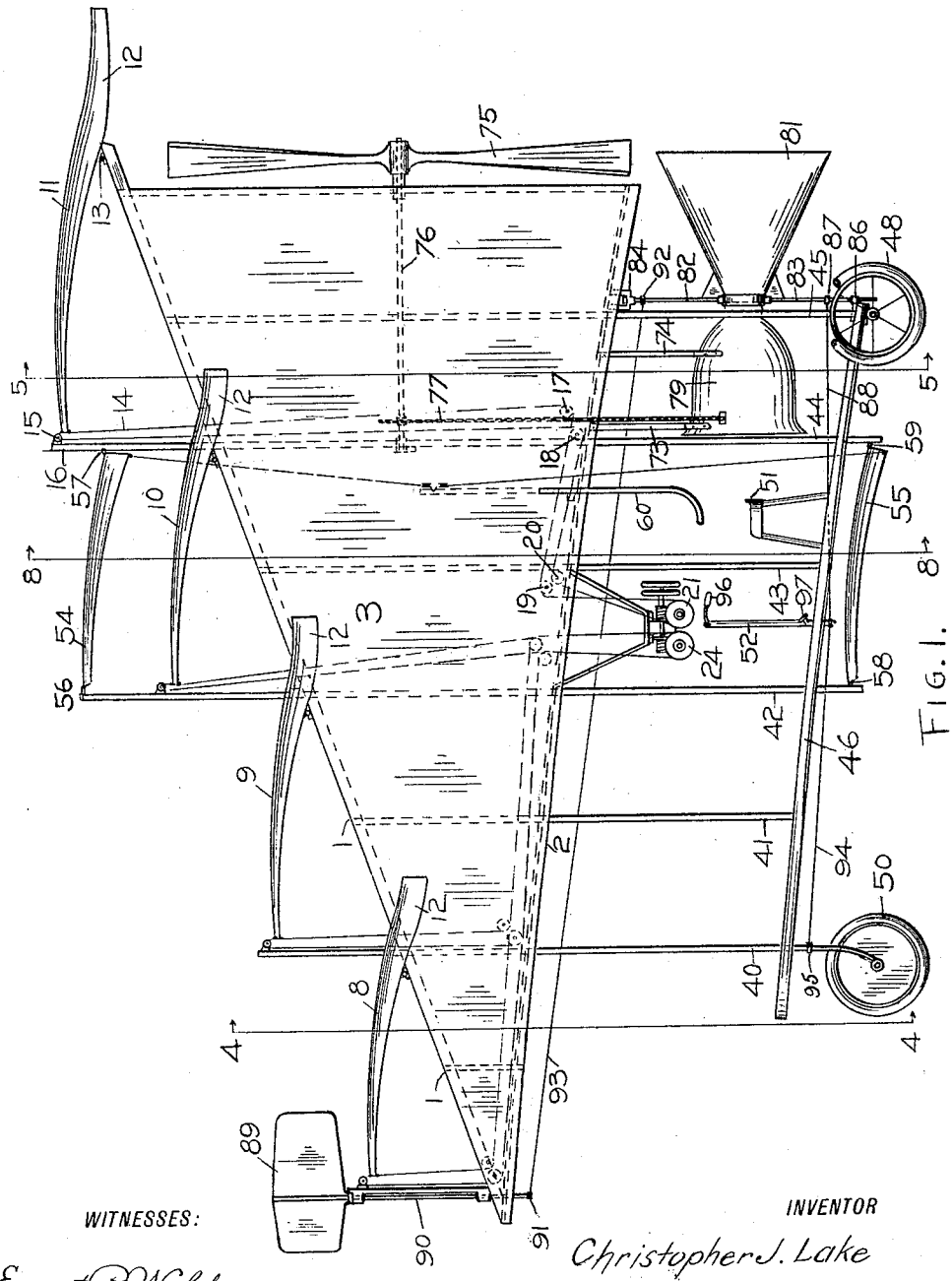

FIG. 1.

WITNESSES:

Ernest P. Wold

M. C. Woodell

INVENTOR

Christopher J. Lake

BY

Spencer & Heath

ATTORNEY

COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

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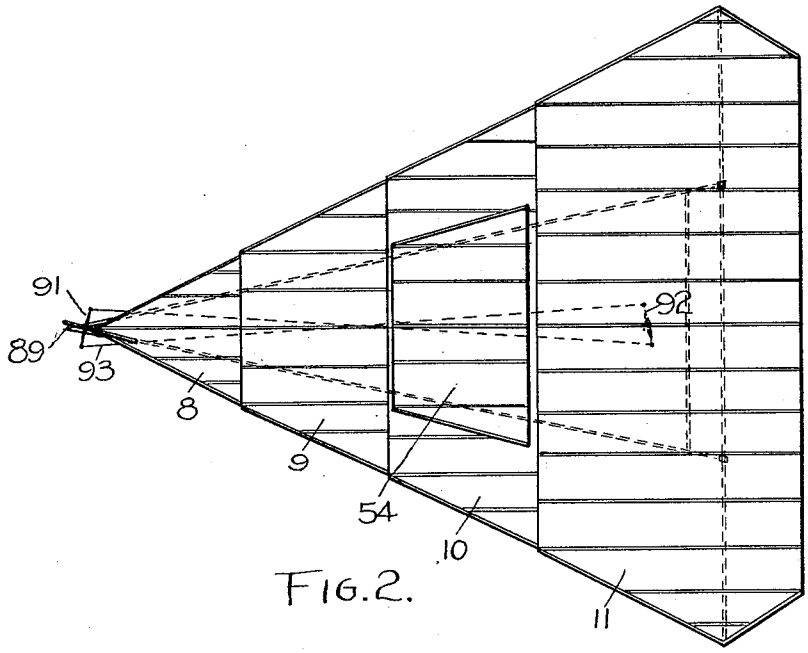


FIG. 2.

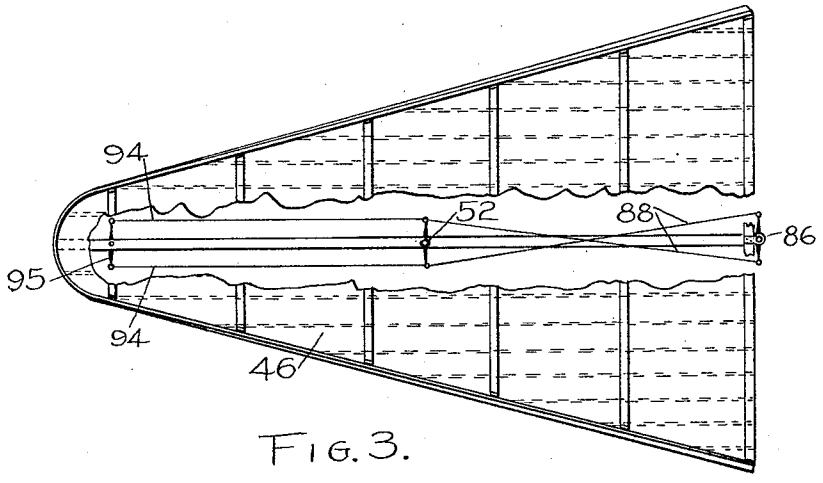


FIG. 3.

WITNESSES:

Ernst P. Wold

M. A. Bloudell

INVENTOR

Christopher J. Lake

BY Spencer Heath

ATTORNEY

COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

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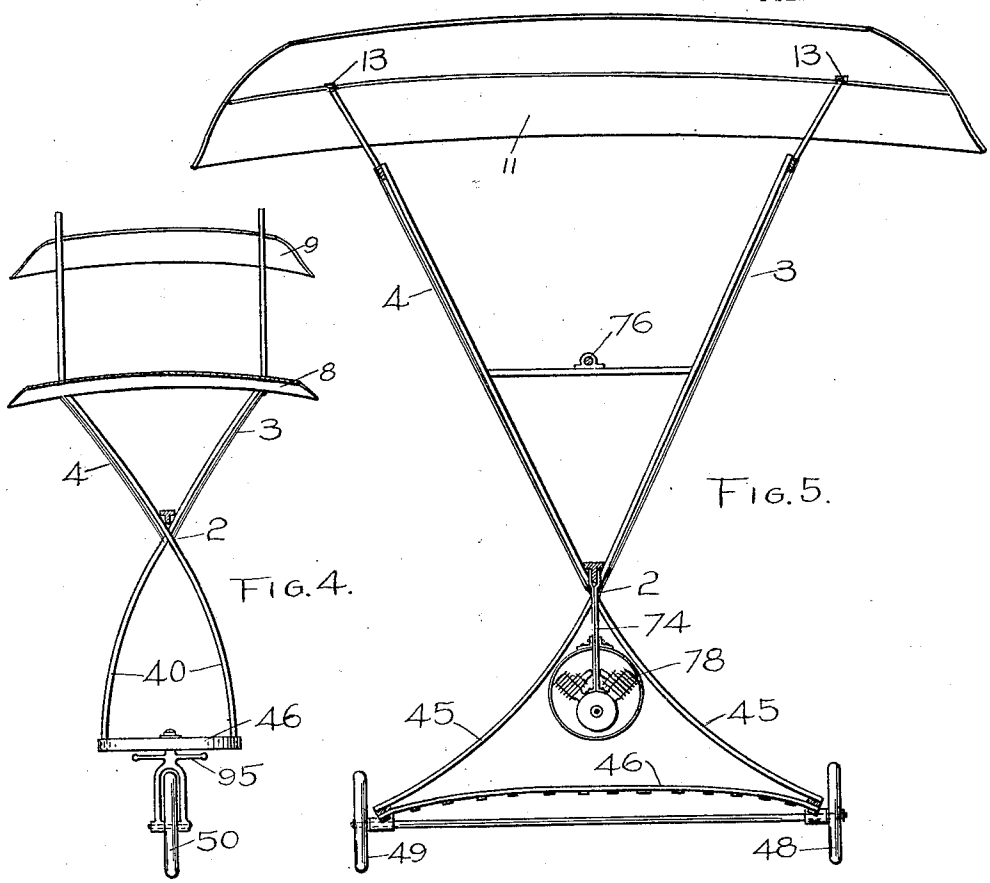


FIG. 4.

FIG. 5.

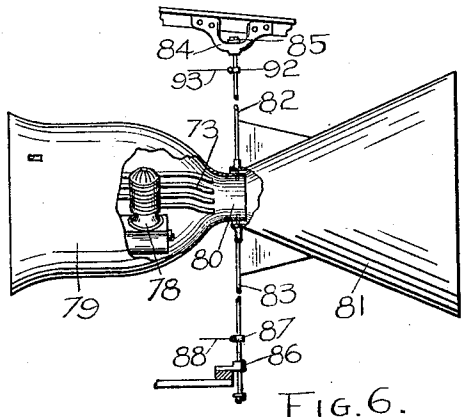


FIG. 6.

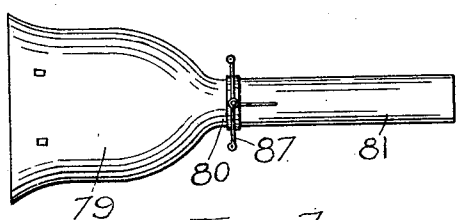


FIG. 7.

WITNESSES:

Ernest P. Wold.

W. A. Bloodgood.

INVENTOR

Christopher J. Lake,

BY Spencer Heath

ATTORNEY

COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

C. J. LAKE.

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4 SHEETS—SHEET 4.

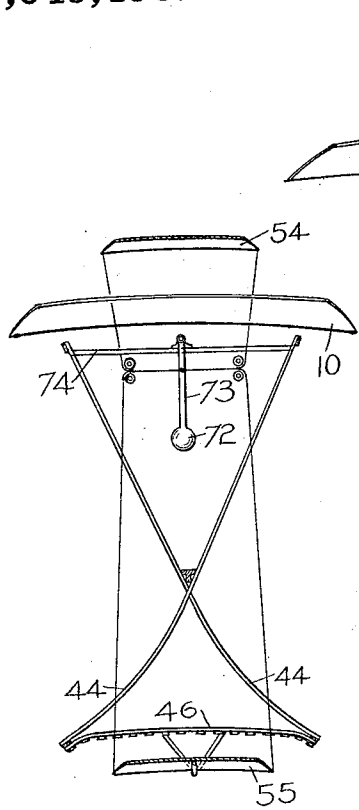


FIG. 9.

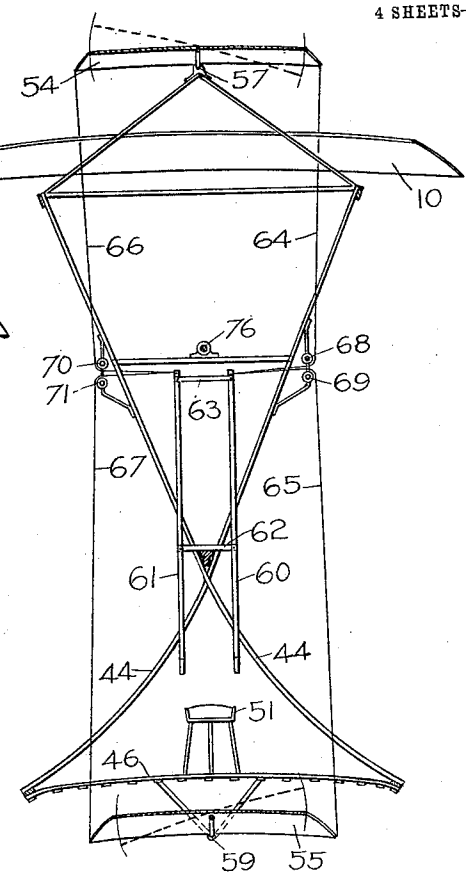


FIG. 8.

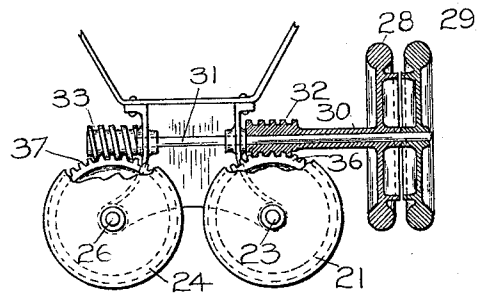


FIG. 10.

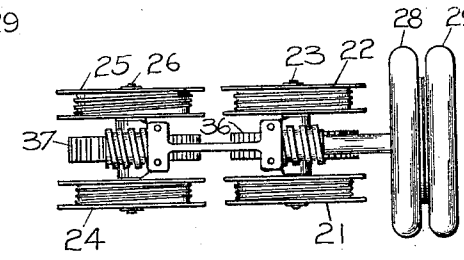


FIG. 11.

WITNESSES:

Ernest P. Wold

M. D. Blondell

INVENTOR

Christopher J. Lake,

BY Spencer & Heath

ATTORNEY

COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C

48

# UNITED STATES PATENT OFFICE.

CHRISTOPHER J. LAKE, OF BRIDGEPORT, CONNECTICUT.

## FLYING OR SOARING MACHINE.

1,049,498. Specification of Letters Patent. Patented Jan. 7, 1913.

Application filed August 9, 1909. Serial No. 512,054.

*To all whom it may concern:*

Be it known that I, CHRISTOPHER J. LAKE, a citizen of the United States, and resident of Bridgeport, in the county of Fairfield and State of Connecticut, have invented certain new and useful Improvements in Flying or Soaring Machines, of which the following is a specification.

This invention relates to flying machines and has for its objects various improvements in the longitudinal and lateral balancing of the machine in the design and construction of the framework to insure resiliency of action, and in the propelling and steering of the machine.

With these objects in view and other objects which will appear, I have invented a new and improved flying machine, one embodiment of which is illustrated on and described by reference to the annexed drawings, in which,

Figure 1 is a side elevation, Fig. 2 is a plan view, Fig. 3 is a floor plan showing steering connections, Fig. 4 is a section on line 4—4 of Fig. 1, Fig. 5 is a section on line 5—5 of Fig. 1, Fig. 6 is a detail elevation of the propelling and steering apparatus, Fig. 7 is a top view of Fig. 6, Fig. 8 is a section on line 8—8 of Fig. 1, Fig. 9 is a section similar to Fig. 8 but showing an alternate construction, and Figs. 10 and 11 are detail views of a portion of the controlling mechanism.

The entire machine is built about a central rigid framework constituting its body or keel portion. This framework forms a triangular pyramid with its apex toward the front and its three edges diverging rearwardly, the two upper edges 1 ascending and the lower edge 2 descending slightly toward the rear. The upper side of the pyramid and its base at the rear are left open for the free passage of air and the two lower sides are covered with fabric forming keel planes 3 and 4 joined together at their lower edges and diverging upwardly. The upper edges of these planes ascending toward the rear provide for the convenient attachment of a gradient series of lifting planes above.

The keel planes 3 and 4 may diverge upwardly and rearwardly at any desired angle. They serve as lifting planes and give lateral equipoise and their gradually increasing width and spread contribute to the steadiness of the machine in the air.

The keel or body portion is surmounted by a series of lifting planes or surfaces 8, 9, 10, and 11 in the manner described in my application for United States Letters Patent No. 484,299 filed March 18, 1909. These surfaces are arranged in an ascending series from front to rear. The forward surface is of triangular form and each succeeding surface is of greater width so that the combined form of the entire series is approximately triangular as shown by Fig. 2. In form, these surfaces, (referring always to the under or working side), are concave in the transverse direction and also concave from front to rear, except that the rearmost portion 12 of each surface is slightly curved in the reverse manner to a longitudinally convex form. The rearmost surface 11 is mounted on hinges 13 and its angle of inclination is controlled by two cords 14 connected with its forward edges and passing over the pulleys 15 mounted on the upright members 16. These cords run over guide pulleys 17, 18, 19 and 20 to a pair of winding drums 21 and 22 mounted on the shaft 23. The surfaces 8, 9 and 10 are also hinged and are controlled in a similar manner by cords led over pulleys to the drums 24 and 25 on shaft 26, the several cords being spliced into one before passing around the drums. The drum mechanism is secured to the bottom of the body portion as shown by Fig. 1 and is shown more in detail by Figs. 10 and 11. The hand wheels 28 and 29 are mounted on concentric shafts 30 and 31 carrying worms 32 and 33 which transmit motion to the drum shafts 23 and 26 by engagement with the gears 36 and 37 respectively, from which it is seen that the wheel 29 gives control of surfaces 8, 9 and 10 and wheel 28 operates the rearmost surface 11, the adjacent arrangement of the wheels on a common axis making it convenient for the operator to turn them either independently or as a single wheel. By this arrangement of the surfaces and controlling mechanism the machine may be caused to rise or fall on an even keel by a slight change in the inclination of the entire series of surfaces throughout the whole length of the machine, or the inclination of the entire machine may be changed by manipulating either the three forward surfaces 8, 9 and 10 or the rear surface 11 alone or by manipulating said surfaces in reverse directions. This manner of preserving the

longitudinal stability has been found greatly superior to the usual practice of operating horizontal rudders at considerable distance in front or at the rear of the center of lift of the machine which are necessarily erratic in their action owing to the long leverage with which they act upon the machine.

The main body or keel portion with its surmounting lifting surfaces is supported by a series of curved flexible members 40, 41, 42, 43, 44 and 45, erected in pairs from the sides of the platform or floor plane 46 and intersecting at the lower edge 2 of the keel portion as shown by Figs. 4 and 5 for members 40 and 45 which are typical of the intermediate pairs. These members continue upwardly beyond their intersection and form a portion of the framing of the body portion. The floor plane is covered with fabric to form a lifting surface and is slightly concave in both directions. It is approximately triangular in form as shown by Fig. 3 and is mounted on wheels 48 and 49 at the rear and a combined rudder and steering wheel 50 at the front the center of which is covered with fabric to act as a rudder in the air. The operator's seat 51 and steering post 52 are mounted on this flexibly connected floor plane, but the entire weight of propelling apparatus, etc., is suspended from the keel or body portion.

The lateral equilibrium of the machine is maintained by the peculiar mounting and operation of the surface 54 located above the center of the machine and the surface 55 located directly below. Surface 54 is pivoted on its longitudinal axis in journals 56 and 57 supported by framing members at each end of the surface. The surface 55 is similarly mounted in journals 58 and 59 and both surfaces are set at an inclination being slightly raised at the front. The manner of operating these equilibrium surfaces is shown by Fig. 8. The members 60 and 61 are loosely bolted near their mid-portion to a fixed bar 62. Their upper ends are linked together by the bar 63 and their lower ends are curved forward to pass under the operator's shoulders. Cords 64, 65, 66 and 67 are attached to the lateral margins of the surfaces and run on each side over fixed pulleys 68, 69, 70 and 71 to the upper extremities of the members 60 and 61. When the upper part of the machine tips toward the right, for example, the operator leans toward the left. This movement, of itself, tends to level the machine by the transposition of the operator's weight but at the same time the motion that he gives to the members 60 and 61 causes them to draw in the cords 64 and 65 and to pay out 66 and 67. This turns each of the two surfaces to the relative positions indicated by dotted lines. When the surfaces are in this position the pressure of the air causes the upper one to move toward the operator's left and the lower one toward the right, thus producing a positive mechanical couple acting from both sides to right the machine. In Fig. 9 the arrangement of the cords and pulleys is the same but the cords are drawn by the movement of the weight 72 instead of the operator's body and the suspension member 73 is pivoted on a fixed member 74 above the point of attachment of the cords. When the machine tips to the right the corresponding swing of the weight 72 moves the surfaces into the same relative position as in Fig. 8 and produces a similar righting effect.

From a view of the combined action of the upper and the lower surfaces it is obvious that with either of them alone a similar action would result, differing however in degree from the action of both together. In some adaptations of the invention, therefore, I omit one of the equilibrium planes, preferably the lower, and operate the other alone. It is also apparent that the surfaces might be made without curvature and turned in a vertical position, being canted over only when necessary to right the machine, but in this vertical position they could not serve as lifting planes. It will also be understood that the inclination of the pivotal axis could be increased to any degree even to a vertical position in which position the surfaces would form vertical rudders which by being turned at opposing angles would produce the same righting movement as the more nearly horizontal surfaces. Since vertical rudders, however, could not aid in lifting the machine and, moreover, would retard the propulsion, I prefer to employ one or more slightly inclined longitudinally pivoted surfaces, but I desire to claim every other form of surface, plane or vane located in vertical alinement with the center of the machine and operating to preserve its lateral trim without deranging the steering or altering the course of the machine.

The machine is driven by a propeller 75 on shaft 76 connected by the chain-and-sprocket gear 77 with a hydro-carbon engine 78 (see Fig. 6) inclosed in a conduit or casing 79 in the manner illustrated in my application for United States Letters Patent, Serial Number 499,031, filed May 28, 1909. The conduit 79 is largest at its forward end and has a contracted throat 80 just back of the engine leading to an expanding extension 81. The exhaust gases from the engine are led by pipes 73 to a point just forward of the throat and discharged therein in a manner to cause a strong current of air through the conduit. The current of air flowing over the engine aids in keeping it properly cooled and at the same time aids

in propulsion by its reaction as it emerges at the rear. The extension 81 is not made integral with the conduit 79 but is formed into a hollow rudder hingeably connected by posts 82 and 83, the ends of which form pintles to engage in holes at the top and bottom of the throat. The engine is supported from the body or keel portion by hangers 73 and 74 (Figs. 1 and 5) and the hollow rudder 81 is supported in the same way by the post 82, the upper end of which is journaled in the bracket 84 with a nut 85 to support it. The post 83 extends down in alinement with 82 through a journal 86 at the rear of the floor plane through which it projects to accommodate variations in the height of the floor plane due to its resilient connections with the keel or body portion. The post 83 carries a cross-arm 87 from which tiller ropes 88 go forward to a similar cross-arm on the steering post 52. The hollow rudder is formed with vertical sides and thus operates in the same manner as the ordinary rudder without impairing its propelling action as a conduit for the current of air and exhaust gases. The latter action, however, increases the efficiency of the steering means by the angularity of its thrust as a propeller. Coöperating with rudder 81 is another rudder 89 mounted above the front of the machine on the shaft 90, the bottom of which carries a cross-arm 91 connected with a similar cross-arm 92 on post 82 by tiller ropes 93, these ropes being crossed as shown by dotted lines in Fig. 2. The two rudders thus coöperate to turn the machine in the same direction and the pressure of the air acting on the opposite side of the upper rudder from the direction of its pressure on the lower one tends to list the machine over promptly to the angle necessary to it before it can turn. For steering the machine when on the ground a pair of tiller ropes 94 go forward from a cross-arm on part 52 to a similar cross-arm 95 on the fork of the combined rudder and wheel 50. The entire steering mechanism, therefore, either on the ground or in the air is controlled from the post 52 either by the handle-bar 96 or the foot-bar 97 indicated in Fig. 1.

One of the great advantages of the form of machine I have described is its natural tendency toward steadiness of flight without manipulation or control. Ample means are provided, however, for keeping or correcting the equipoise. In this manner the present invention departs from the usual practice of placing the controlling planes on surfaces at a great distance from the center of the machine and causing them to work in opposition to the natural tendencies of the machine instead of adjusting the main parts of the machine itself. The means of vertical control (or longitudinal stability) here described operates directly on the machine proper, correcting its own tendencies instead of opposing them by auxiliary attachments extending out at the front or rear.

The surfaces lying mainly forward of the center of the machine and the surface lying back of the center can be raised and lowered at will and owing to the worm-gear control they are rigidly secure against any movement except by the hand of the operator.

The peculiar advantage of the described mode of correcting any lateral instability lies in the fact that it establishes a righting movement due to the action of a positive mechanical couple acting in the desired direction about the longitudinal center line of the machine as an axis. At whatever angle the upper and lower planes are turned the air pressure under them may be resolved into vertical and horizontal components. The former aid in sustaining the machine without effecting the balance; the latter cause it to turn on its longitudinal axis, and neither has any effect on the steering control. This employment of the horizontal components for lateral balancing sharply distinguish the present device from any in use, the most successful of which employ vertical components or surfaces at great lateral distances from the center of the machine, leaving the horizontal components to be reckoned with by special appliances to correct their disturbing effect on the steering of the machine. Another advantage over equilibrium devices operating at great lateral extremes from the center of the machine is that the entire construction is compact and therefore not affected by diverse air currents acting on widely separated surfaces.

The advantages of the hollow rudder are obvious in that the combined functions of propelling and steering are performed by the same piece and that each contributes to the other, the steering being more positive and effective by reason of the angular propelling thrust and the propulsion being more effective by reason of its action in line with the direction in which it is desired that the machine shall turn.

Finally, the proper working of the propelling mechanism, the safety of the entire machine and its occupant is better insured and its life prolonged by using a resilient instead of a rigid framework between the upper portion carrying its vital parts and the lowermost or landing portion, which must sustain the shock of alighting.

What I claim is:—

1. In a flying machine, the combination with a keel or body portion of a gradient series of lifting planes surmounting it and extending throughout its entire length, the body portion being formed of a pyramidal frame-work having its apex at the front and its base at the rear, with the apex

slightly elevated above the lowest portion of the base, the lower sides of the pyramidal frame-work being covered with fabric and the upper side and the base being open for the free passage of air.

2. In a flying machine, in combination, a gradient series of pivotally mounted supporting surfaces extending throughout the entire length of the machine, part of said surfaces lying forward of the center of pressure of the machine and part lying at the rear of said center, and means for varying the inclination of the two groups of surfaces either together or independently each of the other.

3. The combination with a flying machine, of a multiple controlling device for manipulating its parts through cords or wires, said device comprising a series of drum shafts, winding drums secured thereon, a worm gear on each drum shaft, a series of concentric worm-shafts, a worm on each shaft engaging each of the worm-gears, and a series of hand-wheels mounted adjacently to each other on the worm shafts.

4. In a flying machine, an equilibrium device, comprising a pair of pivoted air impact surfaces situated one above and one below the center of the machine, the surfaces being so situated that their centers would be cut by a vertical plane passed through the longitudinal center-line of the machine and means connected with the surfaces whereby to alter their angular positions in opposite directions on their pivots.

5. In a flying machine, an equilibrium device, comprising a longitudinally pivoted air impact surface, the surface being so situated that its center would be cut by a vertical plane passed through the longitudinal center-line of the machine, the pivotal axis of the surface being inclined downward from front to rear, and means connected with the surface whereby to alter its angular position about said axis.

6. In a flying machine, an equilibrium device, comprising a pair of longitudinally pivoted air impact surfaces situated one above and one below the center of the machine, the surfaces being so situated that their centers would be cut by a vertical plane passed through the longitudinal center line of the machine, the pivotal axes of the surfaces being inclined downward from front to rear, and means connected with the surfaces whereby to alter their angular positions in opposite directions about their axes.

7. In a flying machine, in combination with main sustaining surfaces, an equilibrium device comprising a pivoted air-impact surface so situated that its pivotal axis would be cut by a vertical plane passed through the longitudinal center-line of the machine, the surface being inclined downwardly from front to rear, a normally vertical pivoted operating member, means for imparting transverse movements to said member, and operating connections between said member and said surface.

8. In a flying machine, in combination with main sustaining surfaces, an equilibrium device comprising a pivoted air-impact surface so situated that its center would be cut by a vertical plane passed through the longitudinal center-line of the machine, the surface being inclined downwardly from front to rear, a normally vertical pivoted operating member, means for imparting transverse movements to said member, and cords connecting said member with the lateral margins of the surface.

9. In a flying machine, an equilibrium device comprising a pivoted air-impact surface so situated that its center would be cut by a vertical plane passed through the longitudinal center-line of the machine, the surface being inclined downwardly from front to rear, a normally vertical pivoted operating member, means for imparting transverse movements to said member by engagement with the operator's body, and operating connections between said member and said surface.

10. In a flying machine, an equilibrium device comprising a pair of pivoted air-impact surfaces, one above and one below the center of the machine and so situated that their centers would be cut by a vertical plane passed through the longitudinal center-line of the machine, a normally vertical operating member, means for imparting transverse movements to said member, and operating connections between said member and said surfaces whereby to alter their angular positions in opposite directions on their pivots.

11. In a flying machine, an equilibrium device comprising a pair of pivoted air-impact surfaces, one above and one below the center of the machine and so situated that their centers would be cut by a vertical plane passed through the longitudinal center-line of the machine, a normally vertical operating member, means for imparting transverse movements to said member, and cords connecting said member with the lateral margins of the surfaces whereby to alter their angular positions in opposite directions on their pivots.

12. In a flying machine, an equilibrium device comprising a pair of pivoted air-impact surfaces, one above and one below the center of the machine and so situated that their centers would be cut by a vertical plane passed through the longitudinal center-line of the machine, a normally vertical operating member, means for imparting transverse movements to said member by engagement with the operator's body, and operating connections between said member and said sur-

faces whereby to alter their angular positions in opposite directions on their pivots.

13. In a flying machine, an equilibrium device comprising a pair of pivoted air impact surfaces, one above and one below the center of the machine and so situated that their centers would be cut by a vertical plane passed through the longitudinal center-line of the machine, the pivotal axes of the surfaces being inclined downward from front to rear, a normally vertical operating member, means for imparting transverse movements to said member, and operating connections between said member and said surfaces whereby to alter their angular positions in opposite directions on their pivots.

14. In a flying machine, an equilibrium device comprising a pair of pivoted air impact surfaces, one above and one below the center of the machine and so situated that their centers would be cut by a vertical plane passed through the longitudinal center-line of the machine, the pivotal axes of the surfaces being inclined downward from front to rear, a normally vertical operating member, means for imparting transverse movements to said member, and cords connecting said member with the lateral margins of the surfaces whereby to alter their angular positions in opposite directions on their pivots.

15. The combination with a flying machine of an equilibrium device comprising a pair of pivoted air impact surfaces, one above and one below the center of the machine and so situated that their centers would be cut by a vertical plane passed through the longitudinal center-line of the machine, the pivotal axes of the surfaces being inclined downward from front to rear, and a device operative by engagement with the operator's body in such manner that when the operator's body moves toward one side the surfaces will incline toward each other on that side and away from each other on the opposite side.

16. In a flying machine, in combination a body portion, a propelling and power apparatus, the entire propelling apparatus being rigidly connected with the body portion, a landing portion adapted for contact with the ground, and a frame-work connecting the body portion with the landing portion, said connecting frame-work being composed of curved resilient members extending between the two portions.

17. In a flying machine, in combination, a body portion, a propelling and power apparatus, the entire propelling apparatus being rigidly connected with the body portion, a landing portion adapted for contact with the ground, and a frame-work connecting the body portion with the landing portion, said connecting frame-work being composed of curved resilient members extending between the two portions and forming part of the framing structure of the body portion.

18. The combination, in an aeroplane, of fixed main wings, auxiliary sustaining planes mounted centrally above and below said main wings to rock on axes parallel to the longitudinal axis of the aeroplane, and a control mechanism adapted to rock said auxiliary planes in opposite directions on their respective axes.

In testimony whereof I have hereunto set my hand this 6th day of August, A. D., 1909.

CHRISTOPHER J. LAKE.

Witnesses:
G. W. FOOTE,
M. D. BLONDEL.