No. 831,173. PATENTED SEPT. 18, 1906.

J. J. MONTGOMERY.

AEROPLANE.

APPLICATION FILED APR. 26, 1905.

3 SHEETS—SHEET 1.

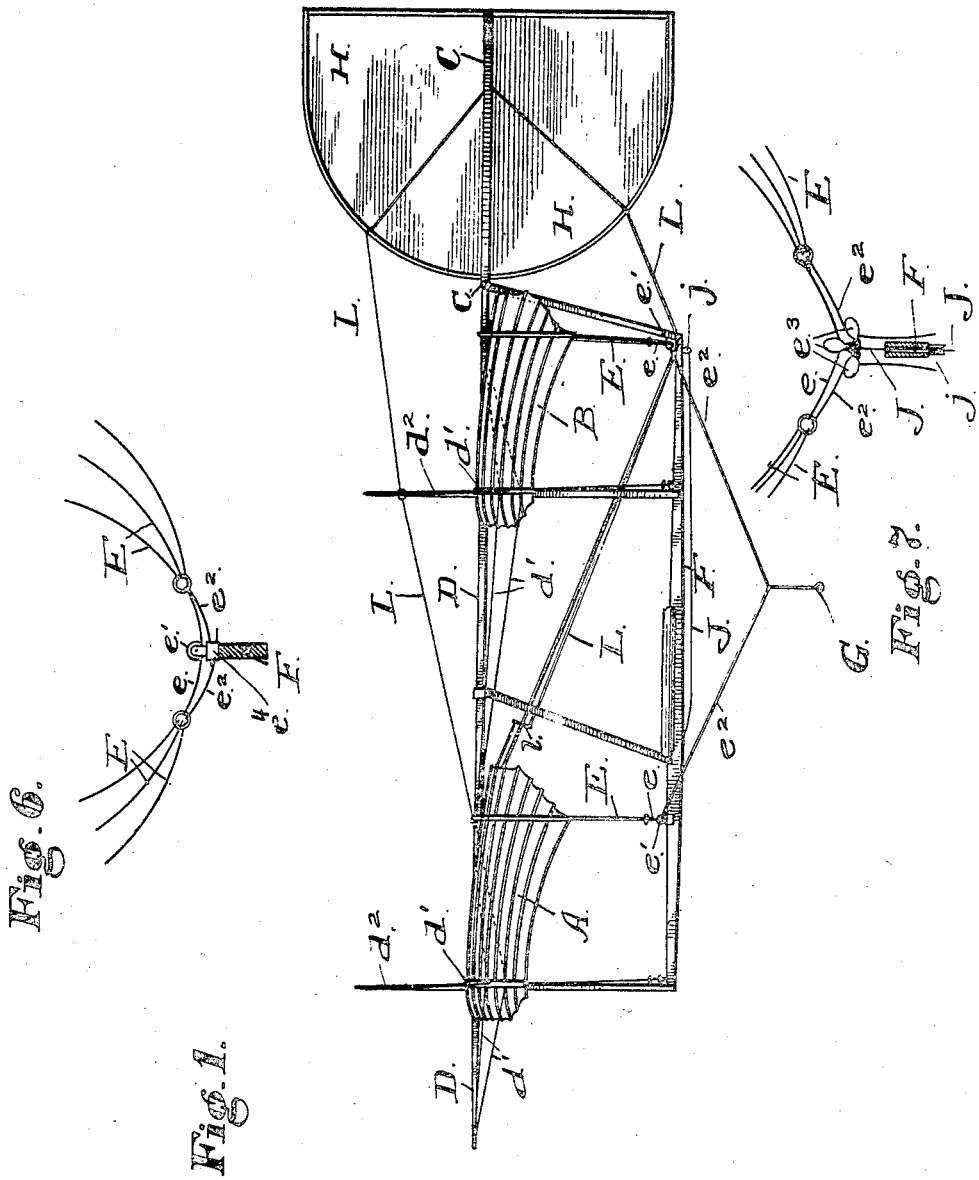

Fig. 1.

Fig. 6.

Fig. 5.

Witnesses.

Arthur L. Slee.

J. Compton.

Inventor.

John J. Montgomery

by Wm. F. Booth

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3 SHEETS—SHEET 2.

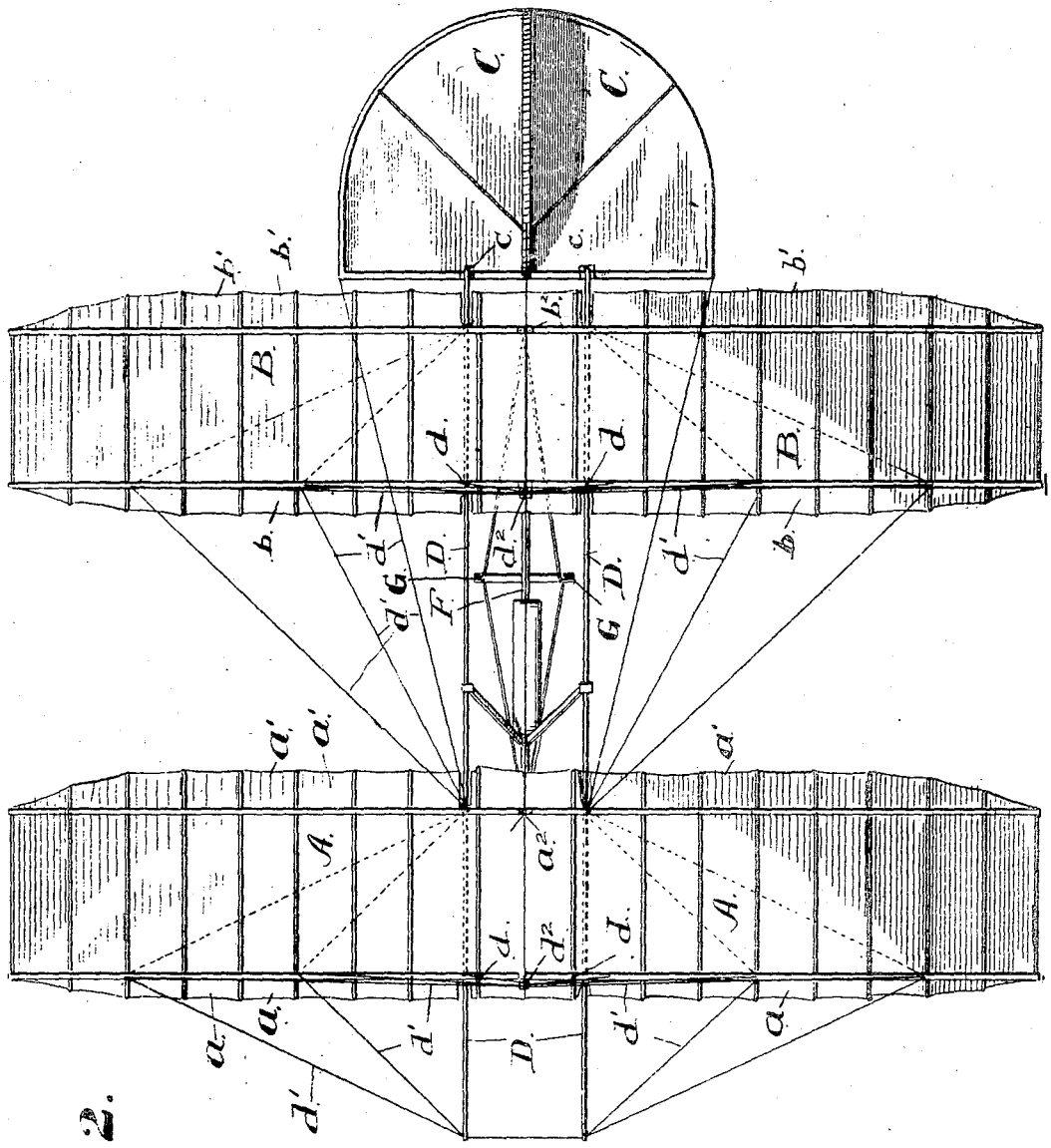

Fig. 2.

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3 SHEETS—SHEET 3.

Fig. 3.

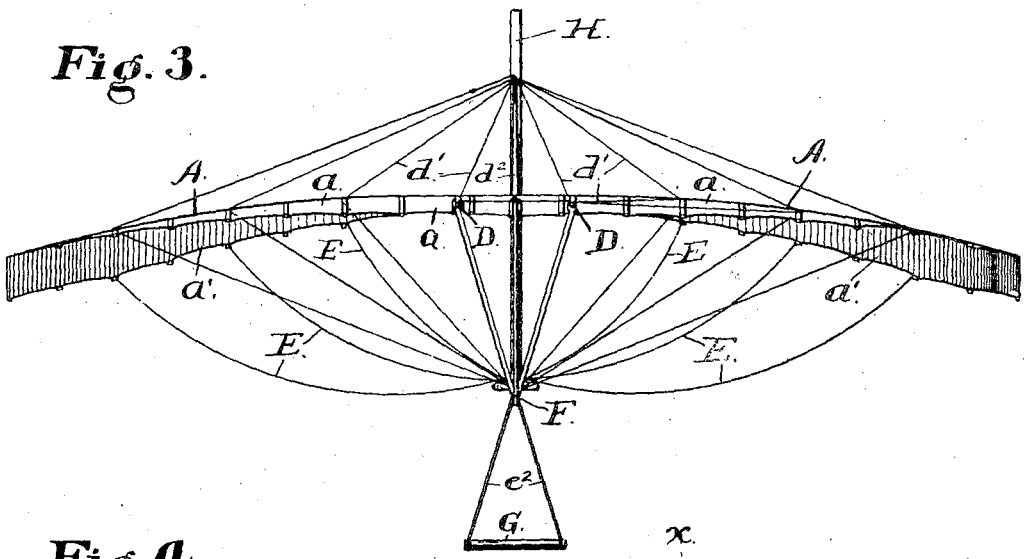


Fig. 4.

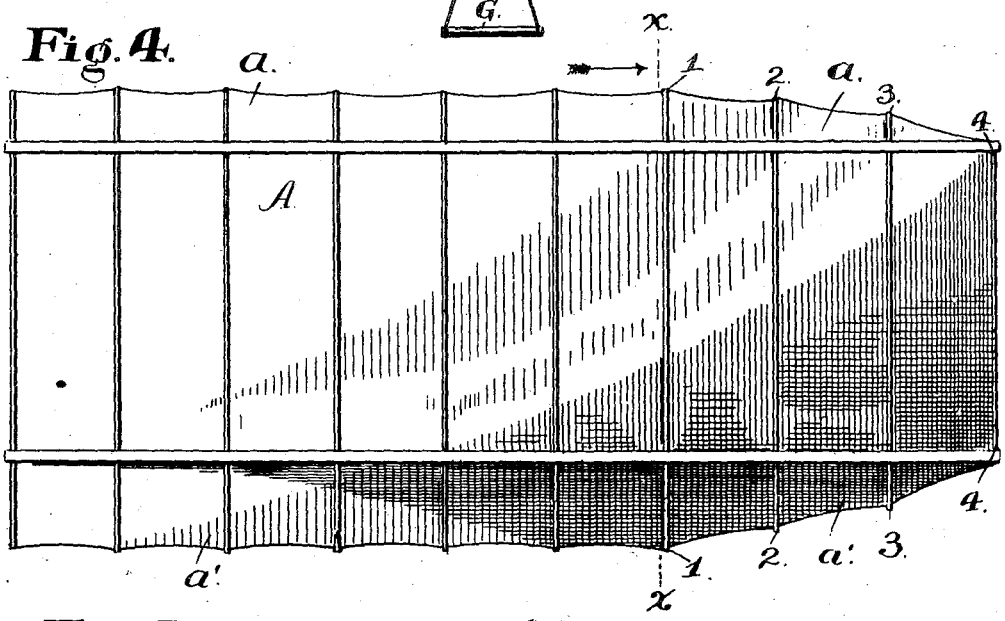
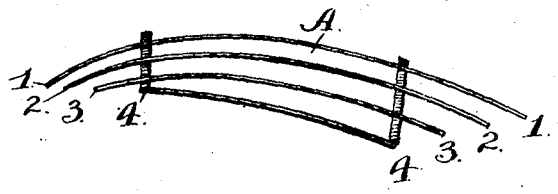


Fig. 5.



Witnesses.
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J. Compton.

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his Attorney

UNITED STATES PATENT OFFICE.

JOHN J. MONTGOMERY, OF SANTA CLARA, CALIFORNIA.

AEROPLANE.

No. 831,173. Specification of Letters Patent. Patented Sept. 18, 1906.

Application filed April 26, 1905. Serial No. 257,403.

To all whom it may concern:

Be it known that I, JOHN J. MONTGOMERY, a citizen of the United States, residing at Santa Clara, county of Santa Clara, State of California, have invented certain new and useful Improvements in Aeroplanes; and I do hereby declare the following to be a full, clear, and exact description of the same.

My invention relates to the class of aeroplanes; and it consists in certain surfaces with means for adjusting them, as I shall hereinafter fully describe.

The object of my invention is to provide a controllable aeroplane device.

Referring to the accompanying drawings, Figure 1 is a side elevation of my aeroplane device. Fig. 2 is a top plan of the same. Fig. 3 is a front view of the same. Fig. 4 is a plan, enlarged, of one side of one wing-surface. Fig. 5 is a cross-section on the line $x\,x$ of Fig. 4. Fig. 6 is a detail view of the controlling wires and cords which change the surface of the aeroplane. Fig. 7 is a detail view of the same adapted for the rear wing-surface in order to vary its inclination to the front wing-surface.

In the form of the device here illustrated, there is a front wing-surface A, a rear wing-surface B, and a horizontal tail-surface C. The wing-surfaces A and B in fore-and-aft or transverse section are curved, the most perfect form of the curve being that of a parabola, whereby the curve in front is sharp and that in the back is relatively more gradual, as seen in Fig. 5. These two surfaces A and B are connected by the bars D of a frame.

The front portions *a* and *b*, respectively, of the wing-surfaces are best curved down from center to ends, as seen in Fig. 3, and are firmly attached to the fore-and-aft bars D at the points *d*. They are also strongly braced in all directions by wires *d'*, running to vertical frame-posts d^2 and to the frame-bars D. The rear portions *a'* and *b'*, respectively, of the wing-surfaces are hinged midway of their length, where their stiffener-bars are severed and hinged together at a^2 and b^2, so that said rear portions are free to droop, but are restrained from upward movement by a series of wires E, attached to the lower beam F of the frame in a manner which I shall presently describe. These rear portions *a'* and *b'* simply rest on the frame-bars D, and thereby having their freedom of movement can assume various positions, like the arms of a balance, thus causing a change in the form of the wing-surfaces on the two sides. This change of surface is for the purpose of guidance and partly for equilibrium and is produced by the following means. The wires E, which are attached above to the rear portion *a'* of the front wing-surface A, pass downwardly from each side of said portion, the group of wires from each side being united below, as shown in Fig. 6, to opposite ends of an equalizing-cable *e* through the intervention of a ring. The equalizing-cable *e* plays freely through a pulley *e'*, secured on top of the lower beam F of the frame of the machine. Secured to the wing terminals of the equalizer-cable *e* are cords e^2, which pass therefrom to the beam and cross each other through a guide e^4 on said beam, and thence said cords pass downwardly and backwardly, as seen in Fig. 1, and are attached to the ends of a cross-foot or stirrup-bar G, as seen in Figs. 2 and 3. The wires E, which are attached above to the rear portion *b'* of the rear wing-surface B, pass downwardly from each side of said portion, the groups of wires from each side being united below, as shown in Fig. 7, to opposite ends of an equalizing-cable similar to the cable *e* in front and similarly lettered through the intervention of a ring. This rear equalizing-cable instead of being guided by a pulley firmly attached to the beam F is guided and plays freely through the upper pulley of a triple sheave, (lettered e^3,) which sheave is connected with and held by a cord J, attached to it. This cord J passes freely through a hole in beam F, as seen in Fig. 7, and is thence guided by a pulley *j* under the beam to a point forward, as shown in Fig. 1, to within reach of the operator. Cords e^2 are secured to the terminal rings of the rear equalizer-cable *e*, as shown in Fig. 7, and thence are guided by the lateral pulleys of the triple sheave e^3 downwardly and backwardly to the foot or stirrup bar G, as seen in Figs. 2 and 1. By pressing down on the stirrup-bar on one side the rear portions of the wing-surfaces on one side are drawn down, while those on the opposite side are allowed to yield to the air-pressure beneath. By these means the wing-surfaces change their form. The pressures on the two sides of the device are varied, and the device may keep its course when meeting a gust, which would tend to tilt it and turn it aside, or it may be made to change its course.

A feature of the arrangement of the cords e^2 (indicated in Fig. 6) is that the one attached

to the left arms passes through the guide E^4 to the right end of the stirrup-bar, and vice versa. Thus a pressure with the right foot will force down the left rear surfaces, making this the stronger side of the device, while the right rear surfaces yielding become the weaker. These changes cause the device to swing to the right.

By simultaneously pressing on both ends of the stirrup-bar all the rear portions of both wing-surfaces are depressed for the purpose of partly meeting the requirements of the fore and aft equilibrium; but this is mainly done by varying the relative inclination of one of the wing-surfaces to that of the other. This last-named variation involves both fore and aft equilibrium and continuance of flight, as I shall presently explain. This adjustment of inclination is accomplished by allowing the free rear portion of the rear wing-surface B to rise under the pressure of the air and by pulling it down again as required by means of its wires E and cords e^2, heretofore described, which, as shown in Fig. 7, are adapted for this independent use as the pulleys e^3 of the rear control are not secured to the beam F, but are held by a separate cord J, which passes within reach of the operator, being guided by a pulley *j*.

In the rear of the device in connection with the tail-surface C there is a large surface H perpendicular to the tail-surface, attached to it and extending both above and below it. The tail-surface is adapted to swing vertically by being hinged at *c* to the rear of the wing-surface B and its movement is effected by means of a cord L, secured to it on each side, Fig. 1, said cord being suitably guided and attached to a sliding handhold *l* within reach of the operator.

The surface H moves vertically with the tail-surface; but it has no side movement, because its function is that of a keel or fin and not that of a rudder. It serves to maintain the side equilibrium, which it does by performing an operation different from that of a rudder. The essentials of this fin-like surface H are, first, that it shall be relatively large; second, that it shall be proximate to the rear surface, and, third, that it shall extend above and below the tail-surface C.

Concerning the fore and aft alined wing-surfaces A and B there are two essential adjustments, first, that of the rear portions of each relatively to the front portions and, second, that of the inclination of one surface relatively to the other. By the first adjustment the surfaces undergo changes of form and the effect is to vary the air-pressures on the two sides of the machine, whereby the device may keep its course, being prevented from tilting or turning aside and may change its course. These results are based upon the essential character of a wing-surface. Investigation has shown me that a wing is a specially-formed surface placed in such a position as to develop a rotary movement in the surrounding air. This position is determined by mathematical considerations. The various requirements of gliding are met by changes in various parts of the wing. The movements in the air are of such a nature as to make it possible to separate the wing-surface, as I have done in my device, into front and rear sections and maintain the special rotary movement of the air which lies at the basis of this phenomenon. The sections though separated have a form and adjustment suitable to themselves, based upon the fundamental formula of formation and adjustment, but these must be coördinate to the idea of one larger wing of which they are supposed to be parts. By the second adjustment—namely, that of the inclination of one wing-surface relatively to the other—the machine maintains equilibrium and flight. If a surface moves at a slight angle through the air, the center of pressure is near the front edge, and the weight carried must be below this point. To meet the requirements of varying speeds of motion, it is necessary to either change the position of the weight or the angle of the surface. This in my device is done by changing the angle between the front and rear wing surfaces A and B. In the process of gliding there must be a continual change in the angle of these surfaces to maintain the proper speed and equilibrium.

Concerning the tail-surface C there must be an up-and-down or vertical adjustment. The tail-surface is in reality but an extension of the rear wing-surface B. By the variation of its angle the pressures in the rear are varied. The same variations are, indeed, produced if the tail be dispensed with and the rear wing-surface is changed in its angle. In other words, whether the tail be a separate surface or only an extension of the rear wing-surface it is enough to say that the rear surface must be adapted to change its angle in part or whole.

The effect of the fin-like surface H is this: If from any cause the machine is tilted to one side and it commences to glide sidewise, though the front parts have an unimpeded side movement, the rear part having the large fin H meets resistance and as a consequence the machine is swung around and continues to travel in the direction it started to fall. This of course takes the machine out of its course. To bring it back again, the wings must be operated as before described. Thus it will be seen this vertical fin-like surface has a distinctive character, due to its size and position, and, though apparently a rudder, is the reverse and not designed to perform the office of a rudder.

Heretofore I have described the wing-surfaces as being curved in cross-section, the best form being parabolic. It must now be

noted that for the best results the form of each side of each wing-surface is specialized, as follows: All the fore-and-aft or cross sections are parabolic curves; but those curves nearer the center are most inclined to the path of movement and thence toward the ends their inclination is gradually decreased, thereby producing a sinuousity of the wing, as shown in Figs. 3 and 5, which is the normal surface from which the various changes are made. In addition to this adjustment or arrangement the curved cross-sections, beginning about two-thirds from the center, are less sharply curved in front, and so continue decreasing in sharp curvature to the ends. This is shown in Figs. 4 and 5, wherein the successive sections 1, 2, 3, and 4 show the gradual cutting off at the front of the sharp beginning of the several parabolic curves. The first of these arrangements—namely, the gradual change in inclination of the cross-curves to the path of movement—is for the purpose of properly meeting and cutting the rising current of air immediately in front of the wing-surface, analysis and experiments having shown that the action of the under surface of a wing is to cause an ascending current of air immediately in front of the wing-surface, this ascending tendency being greatest at the center and gradually diminishing toward the tips. The second arrangement—namely, the diminishing curvature near the ends of the wing—of the forward end of the curves is for the same purpose, but is rendered necessary by the fact that if the foregoing adjustment of the surfaces were continued to the end the sharp curvature of the front edge would force the rear portions of the surface into a too abrupt position relative to its path, thus building up a large unnecessary resistance to the forward movement.

In using the aeroplane the operator sits astride the beam F, with his feet on the stirrup-bar G. With one hand he holds onto the frame and with the other he holds and operates the cord L for adjusting the tail. The machine, with the operator in place, is carried to a height by means of a balloon and is launched from any desired elevation by tripping its connections with the balloon.

Having thus described the invention, what I claim as new, and desire to protect by Letters Patent, is—

1. In an aeroplane device, a curved wing, with means for changing its curvature.

2. In an aeroplane device, a curved wing, with means for adjusting its rear portion relatively to its front portion, to change its curvature.

3. In an aeroplane device, a curved wing, with means for adjusting either side of its rear portion either similarly to or diversely from the other, relatively to the front portion, to change its curvature.

4. In an aeroplane device, a curved wing, having a rigid front portion and an adjustable rear portion with means for adjusting said rear portion relatively to the front portion to change the curvature of said wing.

5. In an aeroplane device, a curved wing having a rigid front portion, and an adjustable rear portion, with means for adjusting either side of its rear portion either similarly to or diversely from the other, relatively to the front portion, to change its curvature.

6. An aeroplane curved parabolically from front to rear, with means for changing its surface.

7. An aeroplane curved parabolically from front to rear with means for adjusting its rear portion relatively to its front portion, to change its surface.

8. An aeroplane curved parabolically from front to rear with means for adjusting either side of its rear portion either similarly to or diversely from the other, relatively to the front portion, to change its curvature.

9. An aeroplane curved parabolically from front to rear, its front portion being rigid, and its rear portion adjustable, with means for adjusting said rear portion relatively to the front portion, to change the surface of the aeroplane.

10. An aeroplane curved parabolically from front to rear, its front portion being rigid, and its rear portion adjustable, with means for adjusting either side of its rear portion either similarly to or diversely from the other, relatively to the front portion, to change its curvature.

11. In an aeroplane device, plural curved wings, one in advance of another, with means for varying the angle of one relatively to another and changing the curvature of each.

12. In an aeroplane device, plural aeroplanes curved parabolically from front to rear, one in advance of another, with means for varying the angle of one relatively to another.

13. In an aeroplane device plural aeroplanes curved parabolically from front to rear, one in advance of another, with means for varying the angle of one relatively to another, and changing the curvature of each.

14. In an aeroplane device, plural aeroplanes, one in advance of another, with means for varying the angle of one relatively to another, and means for adjusting either side of the rear portion of each aeroplane either similarly to or diversely from the other side, relatively to the front portion, to change the surface of each aeroplane.

15. In an aeroplane device, plural aeroplanes, curved parabolically from front to rear, one in advance of another, with means for varying the angle of one relatively to another, and adjusting the rear portion of each aeroplane relatively to its front portion to change the surface of each.

16. A curved aeroplane with means for changing its curvature, and a horizontal tail behind, with means for swinging it vertically.

17. In an aeroplane device, plural curved aeroplanes one in advance of another, and a horizontal tail-surface behind the last aeroplane with means for swinging said tail-surface vertically.

18. In an aeroplane device plural curved aeroplanes, one in advance of another, with means for varying the angle of one relatively to another and a horizontal tail-surface behind the last aeroplane with means for swinging said tail-surface vertically.

19. In an aeroplane device, plural aeroplanes, one in advance of another, with means for varying the angle of one relatively to another and changing the surface of each, and a horizontal tail-surface behind the last aeroplane with means for swinging said tail-surface vertically.

20. In an aeroplane device, plural aeroplanes, one in advance of another, with means for varying the angle of one relatively to another, means for adjusting either side of the rear portion of each aeroplane either similarly to or diversely from the other side, relatively to the front portion, to change the surface of each aeroplane, and a horizontal tail-surface behind the last aeroplane with means for swinging said tail-surface vertically.

21. In an aeroplane device, plural aeroplanes, curved parabolically from front to rear, one in advance of another, with means for varying the angle of one relatively to another, and adjusting the rear portions of each aeroplane relatively to its front portions to change the surface of each, and a horizontal tail-surface behind the last aeroplane with means for swinging said tail-surface vertically.

22. An aeroplane having at its rear a horizontal tail-surface with means for swinging it vertically, and a relatively large fin-surface fixed to the tail-surface perpendicularly.

23. A curved aeroplane with means for changing its curvature said aeroplane having at its rear a horizontal tail-surface, with means for swinging it vertically, and a relatively large fin-surface fixed to the tail-surface perpendicularly.

24. An aeroplane device comprising plural aeroplanes one in advance of another, a horizontal tail-surface at the rear of the last aeroplane with means for swinging it vertically, and a relatively large fin-surface fixed to the tail-surface perpendicularly.

25. In an aeroplane device, plural aeroplanes one in advance of another, with means for varying the angle of one relatively to another and changing the surface of each, and a horizontal tail-surface behind the last aeroplane, with means for swinging said tail-surface vertically, and a fin-surface fixed to the tail-surface perpendicularly.

26. In an aeroplane device, plural aeroplanes, one in advance of another, with means for varying the angle of one relatively to another, means for adjusting either side of the rear portion of each aeroplane either similarly to or diversely from the other side, relatively to the front portion, to change the surface of each aeroplane, and a horizontal tail-surface behind the last aeroplane with means for swinging said tail-surface vertically, and a fin-surface fixed to the tail-surface perpendicularly.

27. In an aeroplane device, plural aeroplanes, curved parabolically from front to rear, one in advance of another, with means for varying the angle of one relatively to another, and adjusting the rear portion of each aeroplane relatively to its front portion to change the surface of each and a horizontal tail-surface behind the last aeroplane, with means for swinging said tail-surface vertically, and a fin-surface fixed to the tail-surface perpendicularly.

28. A curved aeroplane with means for changing its curvature and provided with a fin-surface perpendicular thereto.

29. A curved aeroplane with means for changing its curvature and provided with a fin-surface perpendicular thereto and extending both above and below said aeroplane.

30. An aeroplane curved parabolically from front to rear.

31. An aeroplane curved parabolically from front to rear, its curves, in successive sections from center to ends, decreasing in inclination to the path of travel.

32. An aeroplane curved parabolically from front to rear, its sections near the ends being less sharply curved at their front ends than the forward ends of sections nearer the center.

33. An aeroplane curved parabolically from front to rear, its curves in successive sections from center to ends decreasing in inclination to the path of travel, and its sections near the ends being less sharply curved at their forward ends than the forward ends of sections nearer the center.

34. An aeroplane curved parabolically from front to rear, its curves in successive sections from center to ends decreasing in inclination to the path of travel, its sections near the ends being less sharply curved at their forward ends than the forward ends of sections near the center, and means for changing the surface of said aeroplane.

35. An aeroplane curved parabolically from front to rear, its curves in successive sections from center to ends decreasing in inclination to the path of travel, and its sections near the ends being less sharply curved at their forward ends than the forward ends of sections nearer the center, and means for adjusting the rear portion of said aeroplane relatively to its front portion.

36. An aeroplane curved parabolically from front to rear, its curves in successive sections from center to ends decreasing in inclination to the path of travel, and its sections near the ends being less sharply curved at their forward ends than the forward ends of sections nearer the center, the front portion of said aeroplane being rigid, and means for adjusting its rear portion relatively to its front portion, to change its surface.

37. In an aeroplane device, an aeroplane curved parabolically from front to rear, its curves, in successive sections from center to ends, decreasing in inclination to the path of travel, and a horizontal tail-surface approximate to the rear of said aeroplane, with means for vertically swinging said tail-surface.

38. In an aeroplane device, an aeroplane curved parabolically from front to rear, its curves, in successive sections from center to ends, decreasing in inclination to the path of travel, a horizontal tail-surface approximate to the rear of said aeroplane, with means for vertically swinging said tail-surface, and a fin-surface secured perpendicularly to the tail-surface.

39. In an aeroplane device, an aeroplane curved parabolically from front to rear, its curves, in successive sections from center to ends, decreasing in inclination to the path of travel, a horizontal tail-surface approximate to the rear of said aeroplane, with means for vertically swinging said tail-surface, and a fin-surface secured perpendicularly to the tail-surface and extending both above and below said surface.

40. In an aeroplane device, an aeroplane curved parabolically from front to rear, its curves in successive sections from center to ends decreasing in inclination to the path of travel, and its sections near the ends being less sharply curved at their forward ends than the forward ends of sections nearer the center, and a horizontal tail-surface approximate to the rear of said aeroplane, with means for vertically swinging said tail-surface.

41. In an aeroplane device, an aeroplane curved parabolically from front to rear, its curves in successive sections from center to ends decreasing in inclination to the path of travel, and its sections near the ends being less sharply curved at their forward ends than the forward ends of sections nearer the center, a horizontal tail-surface approximate to the rear of said aeroplane, with means for vertically swinging said tail-surface, and a fin-surface secured perpendicularly to said tail-surface.

42. In an aeroplane device, an aeroplane curved parabolically from front to rear, its curves, in successive sections, from center to ends, decreasing in inclination to the path of travel, with means for changing the surface of said aeroplane, and a tail-surface approximate to the rear of said aeroplane, with means for vertically swinging said tail-surface.

43. In an aeroplane device, an aeroplane curved parabolically from front to rear, its curves in successive sections from center to ends decreasing in inclination to the path of travel and its sections near the ends being less sharply curved at their forward ends than the forward ends of sections nearer the center, with means for changing the surface of said aeroplane, and a tail-surface approximate to the rear end of said aeroplane, with means for vertically swinging said tail-surface.

44. In an aeroplane device, an aeroplane curved parabolically from front to rear, its curves in successive sections from center to ends decreasing in inclination to the path of travel, and its sections near the ends being less sharply curved at their forward ends than the forward ends of sections nearer the center, with means for changing the surface of said aeroplane, a tail-surface approximate to the rear end of said aeroplane, with means for vertically swinging said tail-surface, and a fin-surface secured perpendicularly to the tail-surface.

45. An aeroplane device, comprising plural aeroplanes, one in advance of another, with means for changing the surface of each, and means for varying the angle of one relatively to another, each of said aeroplanes being curved parabolically from front to rear, its curves in successive sections from center to ends decreasing in inclination to the path of travel, and its sections near the ends being less sharply curved at their forward ends than the forward ends of sections nearer the center, a horizontal tail-surface approximate to the rear portion of the last aeroplane, and means for vertically swinging said tail-surface.

46. An aeroplane device, comprising plural aeroplanes, one in advance of another, with means for changing the surface of each, and means for varying the angle of one relatively to another, each of said aeroplanes being curved parabolically from front to rear, its curves in successive sections from center to ends decreasing in inclination to the path of travel, and its sections near the ends being less sharply curved at their forward ends than the forward ends of sections nearer the center, a horizontal tail-surface approximate to the rear portion of the last aeroplane, means for vertically swinging said tail-surface, and a fin-surface secured perpendicularly to the tail-surface.

In witness whereof I have hereunto set my hand.

JOHN J. MONTGOMERY.

In presence of—

J. COMPTON,

D. B. RICHARDS.