T. M. WALLING.

AEROPLANE.

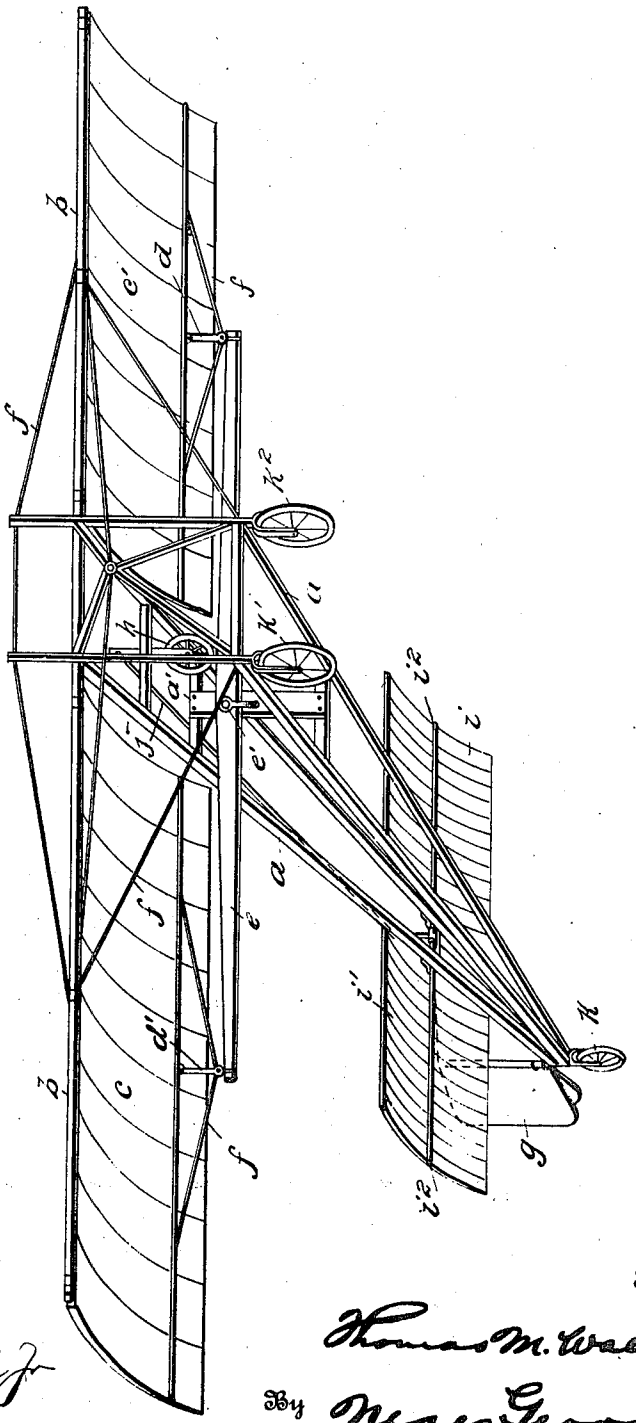
APPLICATION FILED MAY 20, 1910.

1,004,944.

Patented Oct. 3, 1911.

3 SHEETS—SHEET 1.

Fig. 1.



Witnesses

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3 SHEETS—SHEET 2.

Fig. 2.

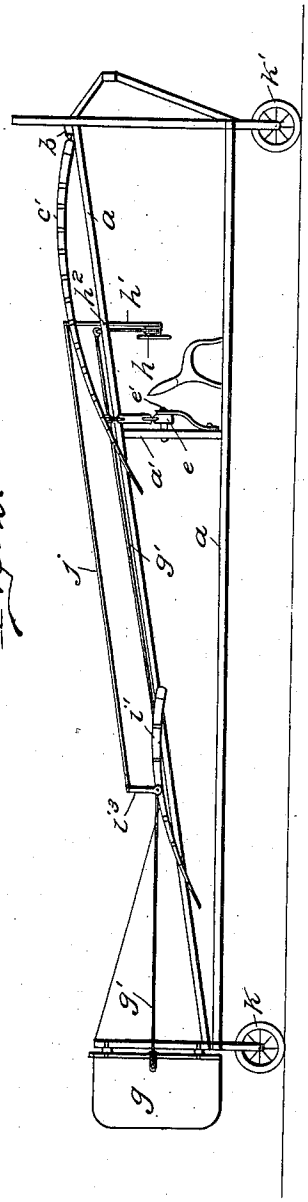
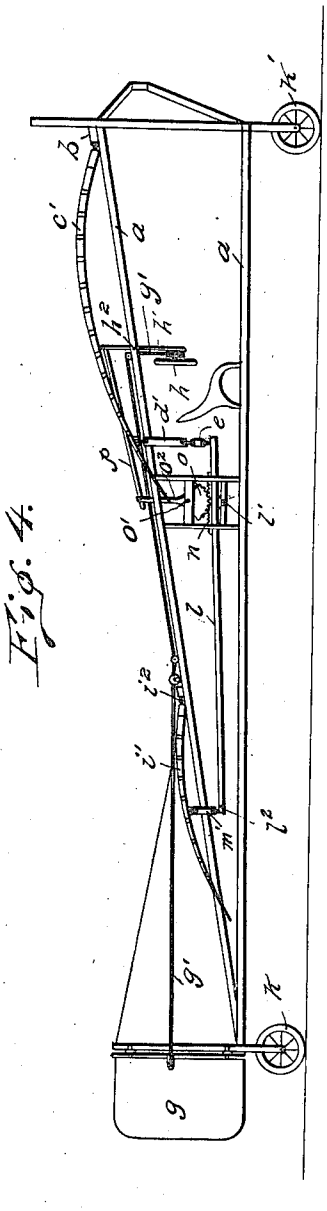


Fig. 4.



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3 SHEETS—SHEET 3.

Fig. 3.

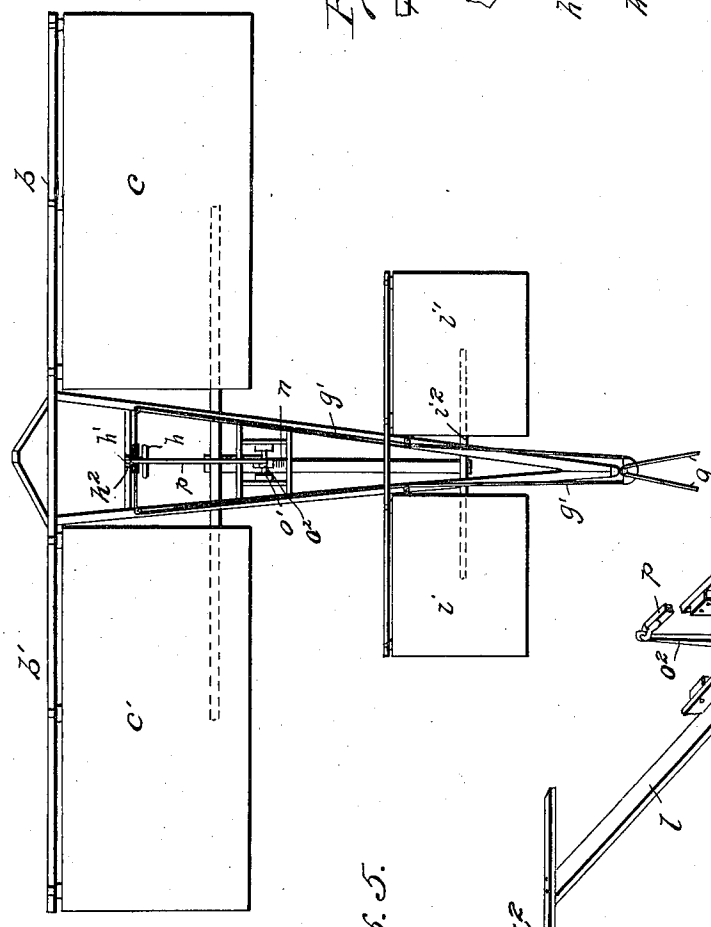

Fig. 6.

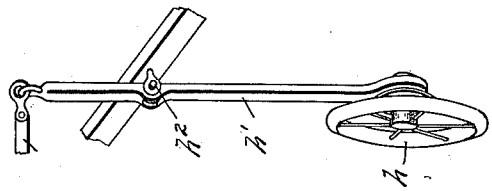

Fig. 5.

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AEROPLANE.

1,004,944. Specification of Letters Patent. Patented Oct. 3, 1911.

Application filed May 20, 1910. Serial No. 562,499.

To all whom it may concern:

Be it known that I, THOMAS MALCOLM WALLING, citizen of the United States, residing at Tinton Falls, Monmouth county, New Jersey, 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 invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to aeroplanes, under which designation are included all devices for carrying passengers or other loads which are sustained above the ground by virtue of the upward pressure of the air brought into play by the movement of the device through the same, and not merely by virtue of the buoyant action of the air.

My invention may be applied both to aeroplanes of the biplane type and those of the monoplane type, and generally to apparatus having air supported surfaces sustained by upward pressure of the air caused by the movement of the apparatus through the air.

In the normal flight of aeroplanes it is necessary to maintain their position substantially horizontal in the direction of their course as well as laterally. For the first-named purpose they are usually provided with supplemental air sustained surfaces or planes whose inclination with respect to the main air-sustained surfaces may be varied at the will of the operator or passenger, and which are known as guiding or steering planes or height regulating rudders. They serve to prevent the aeroplane from dipping or from soaring by inclining them upward or downward to the required degree.

To prevent the aeroplane from tilting laterally or careening, for example, when turning a curve, which action is due to the fact that the outer ends or side of the air supported planes then travel with greater speed than the inner ends or sides and consequently the upward air pressure on the former is greater than on the latter, two expedients have generally been resorted to. One of these consists in providing vanes on the two sides of the aeroplane, which vanes are so arranged as to be swung in opposite directions about an axis transverse to the general direction of movement of the aeroplane, so that the vane on the outer side decreases the upward air pressure at that side of the aeroplane while the vane on the inner side serves to increase that on the inner side. The other expedient consists in warping one of the main air supported planes, *e. g.* in the case of biplanar machines, so that the rear inner angle and the forward outer angle of said plane are drawn down, or the outer forward angle and inner forward angle are inclined downward and upward, respectively, thereby adding an upward impulse to the inner side and a downward impulse to the outer side, both of which together serve to right the aeroplane laterally.

Both expedients, generically considered, can be defined as oppositely varying the inclinations of the opposite sides of the air supported surfaces, since under the first form the pivotal vanes constitute supplemental air supported surfaces.

Heretofore the variation of the inclination of the air-supported surfaces has been done by the operator or passenger and it required considerable skill, practice and experience to properly manipulate the means for this purpose, and in fact, accidents are liable to arise by reason of want of sufficient skill in this respect and by mistakes and oversight.

It is the object of this invention to remove this danger and also to diminish the task of the operator by providing automatic means for varying the inclinations of the air-supported surfaces.

The present invention, with this object in view, consists in so arranging and constructing an aeroplane that any variation in upward pressure of the air upon the respective vanes, whether due to uneven air currents in forward flight or to the greater speed of one vane in turning, will automatically vary the inclination of the vanes in opposite directions in the manner and to the extent required to restore equality in the upward thrust of the air and thus preserve the equilibrium of the machine.

The invention, as hereinafter more particularly described and as set out in the accompanying claims, will be the more readily understood from an inspection of the accompanying drawings, in which—

Figure 1 represents in perspective, from below, an aeroplane embodying my invention; Fig. 2 is a side view of the same; Fig.

3 is a view from above of a modification; Fig. 4 is a side view of the machine illustrated in Fig. 3; and Figs. 5 and 6 are details of the controlling mechanism.

Referring to Figs. 1 and 2, it will be observed that extending transversely of the elongated frame *a* of the machine, is a yard *b*, to which is hinged or otherwise pivotally secured the forward edge of the anterior pair of vanes *c*, *c'*, the rear edge of each of these vanes being connected by means of links *d*, *d'*, to the opposite ends of a lever *e*, which is fulcrumed at *e'* to the cross-brace *a'*, secured to the frame *a*, said lever, as shown, being arranged to the rear of the axis on which the vanes *c c'* are pivoted and at a point substantially opposite the said vanes. Guy wires *f* serve to maintain the several parts just described in proper relation to each other without interfering with the pivotal movement of the vanes or the rocking of the lever.

The operation of the device thus far described is as follows:—So long as the pressure of the air upon the lower side of the two vanes *c*, *c'*, is uniform, they will maintain their relative positions in substantially the same plane. If, however, the pressure under the vane *c*, for instance, be momentarily increased, either by uneven air currents or by turning sharply so as to cause the vane *c* to traverse a larger arc and consequently at greater speed than the vane *c'*, such increased pressure upon the under side of the vane *c* will cause the rear edge thereof to lift, carrying with it that end of the lever *e* to which it is attached by the link *d*. This will cause a corresponding downward movement of the opposite end of the lever and the rear edge of the vane *c'*. Thus the angle of incidence of the vane *c* is diminished and that of the vane *c'* is increased, so that the lifting effect upon the vane *c'* is greater than upon the vane *c*, whereupon the lever *e* is by this same inequality of pressure restored to its former position and lateral equilibrium of the machine maintained.

In addition to the entirely automatic means for maintaining the equilibrium of the aeroplane I have provided manually operable means for guiding the machine both vertically and horizontally, such means consisting of a V-shaped rudder *g* connected by means of a cord *g'* to the drum of a steering-wheel *h*, arranged conveniently in front of the aviator. This steering-wheel *h* is mounted upon one end of a lever *h'*, fulcrumed at h^2 to the frame-work of the machine.

The posterior vanes *i*, *i'* are pivoted along their medial portion to the yard i^2, journaled transversely of the machine-frame parallel to the yard *b*. An arm i^3, extending upwardly from the yard i^2, is connected by means of a rigid rod *j*, with the upper end of the lever *h'*, whereby the aviator may, by moving the steering-wheel and lever toward and from himself, cause the posterior guiding vanes *i*, *i'*, to tilt upon the yard i^2, as a horizontal axis, so as to direct the aeroplane in a downward or upward course.

The machine, as a whole, is shown as provided with launching-wheels *k*, *k'*, k^2, in the usual manner.

In Figs. 3 to 6 inclusive, I have illustrated a modification of the invention which, in addition to the automatic provision for lateral equalization, also provides for the automatic maintenance of longitudinal balance. Here the balancing lever *e* instead of being pivoted to a rigid portion of the frame, is pivoted to a second lever *l*, fulcrumed upon the pin *l'* and provided at its rear end with a cross bar l^2, rigidly affixed thereto and connected at its two extremities, viewed laterally of the machine, by means of links *m*, *m'*, to the rear portion of the posterior guiding vanes *i*, *i'*; which, in this case, are preferably hinged at their forward edge instead of along their medial portion, although either arrangement would suffice. However, in practice the best results are obtained by hinging these vanes at their forward portion. The length of the two arms of the lever *l* are so proportioned in relation to the relative lifting power of the anterior and posterior vanes, that the one equalizes the other.

The operation is as follows: If the pressure on the under surface of the anterior vanes *c*, *c'* becomes less than that on the posterior vanes, causing a tendency of the machine to dip, the greater moment of the pressure on the posterior vanes will elevate the rear end of the lever *l*, depressing the forward end of the same and thus increasing the angle of incidence of the anterior vanes relative to that of the posterior vanes, the resultant increased pressure upon the anterior vanes again lifting the forward end of the lever *l* and restoring the equilibrium of the machine. In order to adapt this balancing device to be controlled by the operator so as to enable him to take an upward or a downward course at will, the fulcrum of the lever *l* is arranged to be shifted in the manner following: Upon the upper surface of the lever is arranged a rack *n*, engaged by a sector *o*, pivoted at *o'*, and provided with an upwardly extending arm o^2, which arm is connected by means of the rigid rod *p* to the upper extremity of the operating lever *h'*. This operating lever as in the former case carries at its lower end a steering wheel *h* connected by means of the cord *g'* to the V-shaped rudder *g*, as before. By pushing forward upon the operating lever by means of the steering wheel the operator

moves the arm o^2 to the rear and the balancing lever l to the front, thus increasing the length of that arm of the lever attached to the anterior vane and decreasing that arm attached to the posterior vane, whereby the now greater moment of the pressure on the anterior vanes is able to elevate the forward end of the lever and depress the rear end, bringing about a change in the angle of incidence of the two vanes and causing the machine to descend.

In order to rise, the aviator pulls the operating lever toward himself by means of the steering wheel h, whereby the balancing lever l is shifted to the rear, increasing the length of that arm attached to the posterior vane and decreasing that attached to the anterior vane, whereby, although the pressure on the two vanes be equal, the leverage of the posterior vanes is increased and the rear end of the lever l is elevated and the forward end depressed, so that the inclination of the two vanes is oppositely varied and the resultant change in the angle of incidence in the two vanes causes the machine to rise.

Having thus described my invention, what I claim, is:—

1. In an aeroplane, a pair of air-supported vanes extending laterally on the sides of the machine, and a yard extending transversely of the line of normal flight on which said vanes are mounted, the rear portions of said vanes being free, in combination with a lever fulcrumed on the machine at a point to the rear of the yard, and means for connecting each arm of the lever with the rear portion of the vanes, whereby the increase of air pressure on one of the vanes acting to lift the same will cause the other vane to be depressed.

2. In an aeroplane, a pair of air-supported vanes extending laterally on the two sides of the machine, said vanes pivoted along their anterior edge upon an axis extending transversely of the line of normal flight, a lever fulcrumed to the machine at a point between the two vanes and below the free posterior edge thereof, and links connecting each arm of the lever with the posterior edge of a vane, whereby any increase of air pressure upon one of the vanes acting to lift the same will cause the opposite vane to be depressed.

3. In an aeroplane, air-supported vanes extending laterally on both sides of the machine and pivoted at their forward portion upon a horizontal axis extending transversely of the line of normal flight, and posterior guiding vanes arranged in substantially the same plane as the supporting vanes and likewise pivoted upon a transverse axis, a lever extending longitudinally of the machine and pivoted intermediate the two sets of vanes, and a connection between each arm of the lever and the free portion of a set of vanes.

4. In an aeroplane, a pair of main air supported vanes extending laterally on both sides of the machine and pivoted at their forward portions on an axis extending transversely of the line of normal flight, posterior guiding vanes arranged in substantially the same direction as the main supporting vanes and likewise pivoted at their forward portion on a horizontal transverse axis, in combination with a lever extending longitudinally of the machine and fulcrumed intermediately of the two sets of vanes, and a connection between each arm of the lever and the free portion of the respective set of vanes, the arm of shorter length being connected to the set of vanes exercising the greatest lifting momentum so as to maintain the equilibrium between the lifting action of the two sets of vanes.

5. In an aeroplane, a pair of main air supported vanes extending laterally on both sides of the machine and pivoted at their forward portion on an axis extending transversely of the line of normal flight, posterior guiding vanes arranged in substantially the same direction as the main supporting vanes and likewise pivoted on a horizontal transverse axis, in combination with a lever extending longitudinally of the machine and fulcrumed intermediately of the two sets of vanes, a connection between each arm of the lever and the free portion of the respective set of vanes, the lever arm of shorter length being connected to the set of vanes exercising the greater lifting momentum, so as to maintain an equilibrium between the lifting action of the two sets of vanes, and means to vary the relative length of the lever arms.

6. In an aeroplane, a pair of air-supported vanes extending laterally on both sides of the machine and pivoted along their forward edge upon an axis extending transversely of the line of normal flight, posterior guiding vanes arranged in substantially the same plane as the supporting vanes and likewise pivoted along the forward edge upon a horizontal transverse axis, a lever extending longitudinally of the machine and fulcrumed intermediate the two sets of vanes, a connection between the rear arm of the lever and the free portion of the guiding vanes, a balancing lever fulcrumed on the forward end of the first named lever, and a connection between each arm of the balancing lever and the free portion of one of the pair of supporting vanes, the first-named lever through its above-mentioned connections with the rear portions of the anterior and posterior vanes, and through its oscillation about its above-mentioned fulcrum, serving to oscillate the said vanes vertically in opposite directions, so as to equalize their moments about this fulcrum and the position

of said fulcrum during horizontal flying being such as to cause the anterior and posterior vanes to assume a position in which their lifting powers are equal.

7. In an aeroplane, a pair of anteriorly arranged supporting vanes extending laterally on the two sides of the machine and independently pivoted at their forward portion upon a horizontal axis extending transversely of the line of normal flight, a pair of posterior guiding vanes pivoted along their forward edge upon a horizontal axis extending transversely of the line of flight, a lever arranged longitudinally of the machine and resting upon a fulcrum at a point intermediate the two sets of vanes, a connection between the rear arm of said lever and the free portion of the posterior vanes, a balancing lever fulcrumed to the forward arm of the first lever, a connection between each arm of the balancing lever and a free portion of an anterior vane, the first-named lever through its above-mentioned connections with the rear portions of the anterior and posterior vanes, and through its oscillation about its above-mentioned fulcrum, serving to oscillate the said vanes vertically in opposite directions, so as to equalize their moments about said fulcrum and the position of said fulcrum during horizontal flying being such as to cause the anterior and posterior vanes to assume a position in which their lifting powers are equal, and manually operable means to vary the relative length of the two arms of said lever.

8. In an aeroplane, a pair of anteriorly arranged supporting vanes extending laterally on opposite sides of the machine and independently pivoted at their forward portion upon a horizontal axis extending transversely of the line of normal flight, a pair of posterior guiding vanes pivoted at their forward portion upon a horizontal axis extending transversely of the line of flight, a lever arranged longitudinally of the machine and resting upon a fulcrum at a point intermediate the two sets of vanes, a connection between one arm of said lever and the free portion of the posterior vanes, a balancing lever fulcrumed to the forward arm of the first lever, a connection between each arm of the balancing lever and a free portion of an anterior vane, the first-named lever through its above-mentioned connections with the rear portions of the anterior and posterior vanes, and through its oscillation about its above-mentioned fulcrum, serving to oscillate the said vanes vertically in opposite directions, so as to equalize their moments about said fulcrum and the position of said fulcrum during horizontal flying being such as to cause the anterior and posterior vanes to assume a position in which their lifting powers are equal, a rack carried by the first-named lever, a sector engaging said rack, a manually operable guiding lever, and a connection between one arm of the guiding lever and the sector, whereby the relative length of the two arms of the longitudinal lever may be varied at will.

9. In an aeroplane, a pair of anteriorly arranged supporting vanes extending laterally on the two sides of the machine and independently pivoted at their forward portion upon a horizontal axis extending transversely of the line of normal flight, a pair of posterior guiding vanes pivoted at their forward portion upon a horizontal axis extending transversely of the line of flight, a lever arranged longitudinally of the machine and resting upon a fulcrum at a point intermediate the two sets of vanes, a connection between one arm of said lever and the free portion of the posterior vanes, a balancing lever fulcrumed to the forward arm of the first lever, a connection between each arm of the balancing lever and a free portion of an anterior vane, the first-named lever through its above-mentioned connections with the rear portions of the anterior and posterior vanes, and through its oscillation about its above-mentioned fulcrum, serving to oscillate the said vanes vertically in opposite directions, so as to equalize their moments about said fulcrum and the position of said fulcrum during horizontal flying being such as to cause the anterior and posterior vanes to assume a position in which their lifting powers are equal, manually operable means to vary the relative length of the two arms of said lever, a steering rudder pivoted upon a vertical axis and V-shaped in cross section a steering wheel carried by the driving lever, and a steering cord connecting the rudder with the drum of the steering wheel.

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

THOMAS MALCOLM WALLING.

Witnesses:

CHAS. PINTARD,

ALBERT VAN WICKLE.