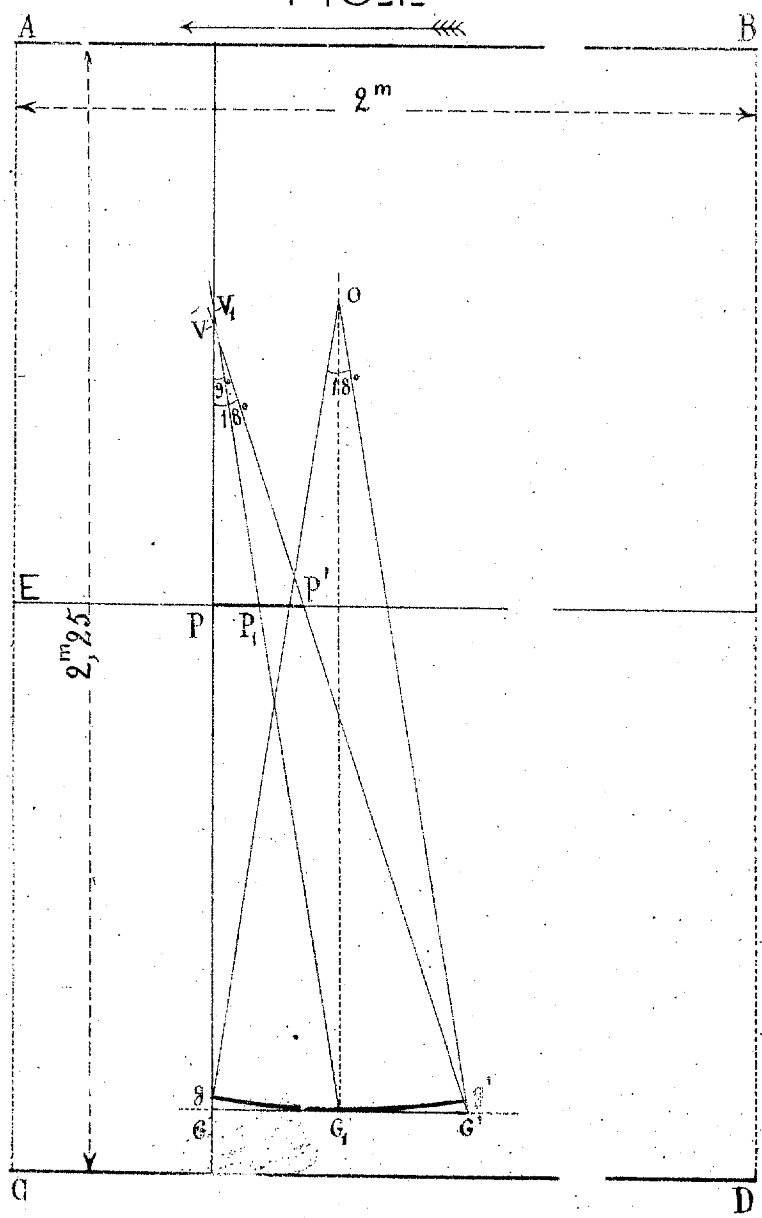
P. SCHMITT.
AEROPLANE.
APPLICATION FILED SEPT. 22, 1909.

1,000,697. Patented Aug. 15, 1911.

5 SHEETS—SHEET 1.

FIG_1_



Witnesses:
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5 SHEETS—SHEET 2.

FIG_2_

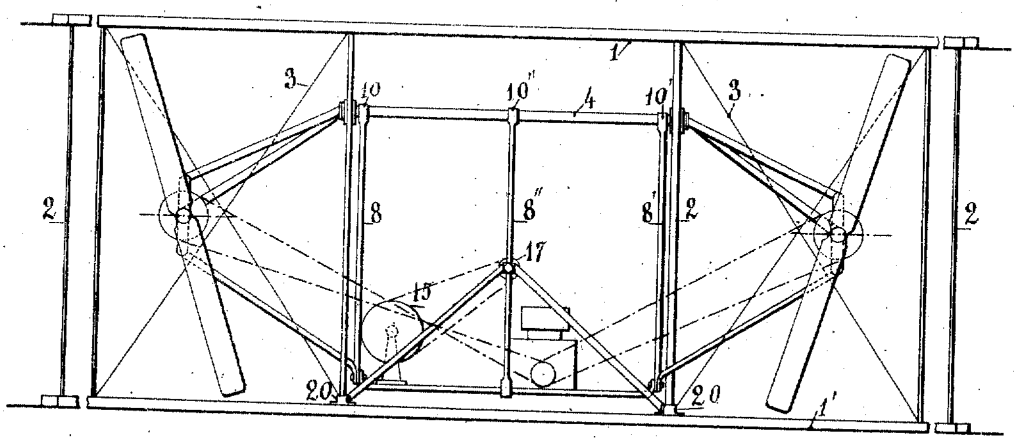
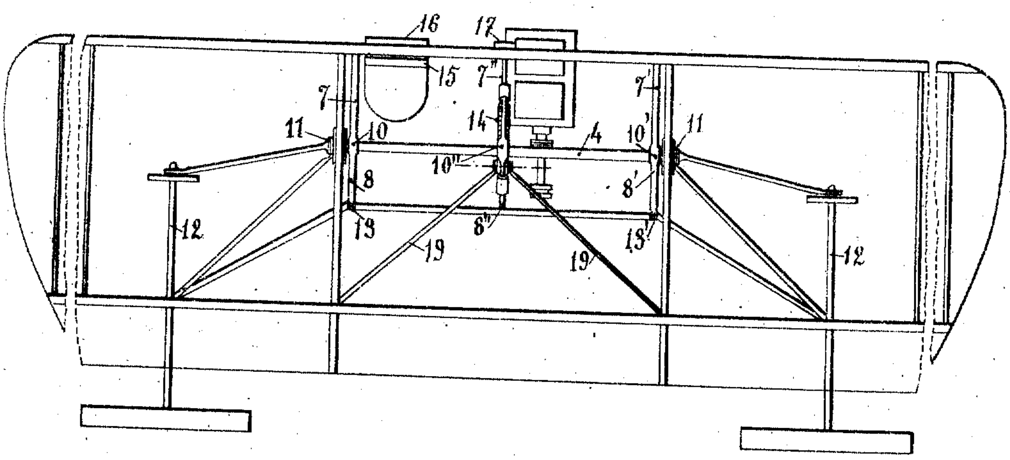


FIG_3_



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6 SHEETS—SHEET 3.

FIG_4_

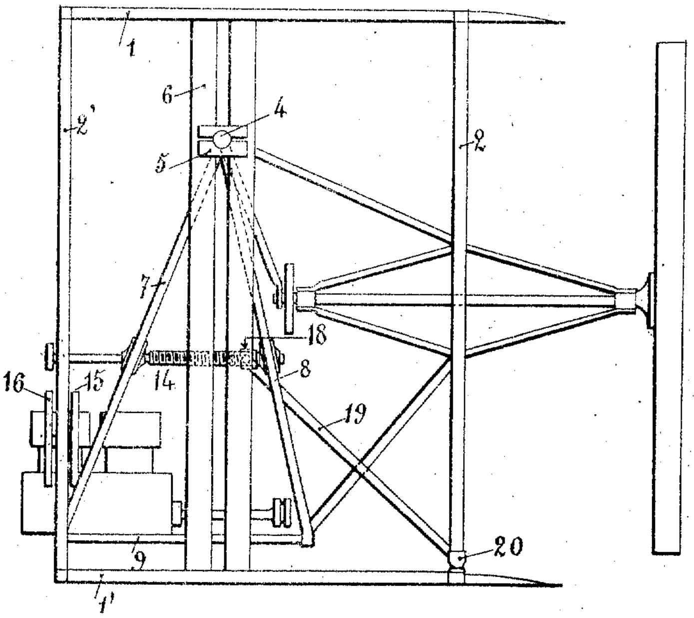
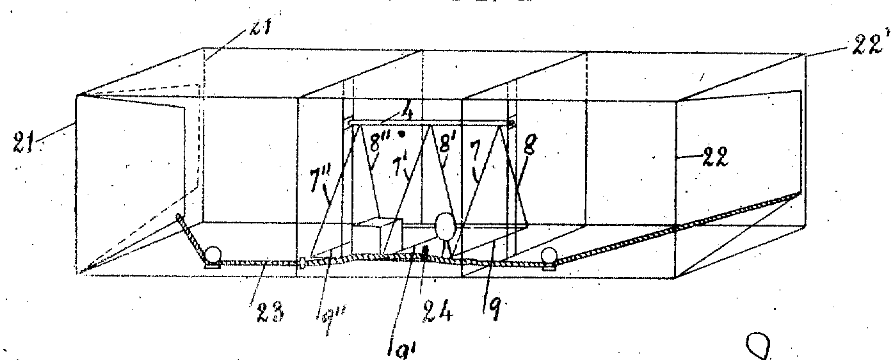


FIG_7_



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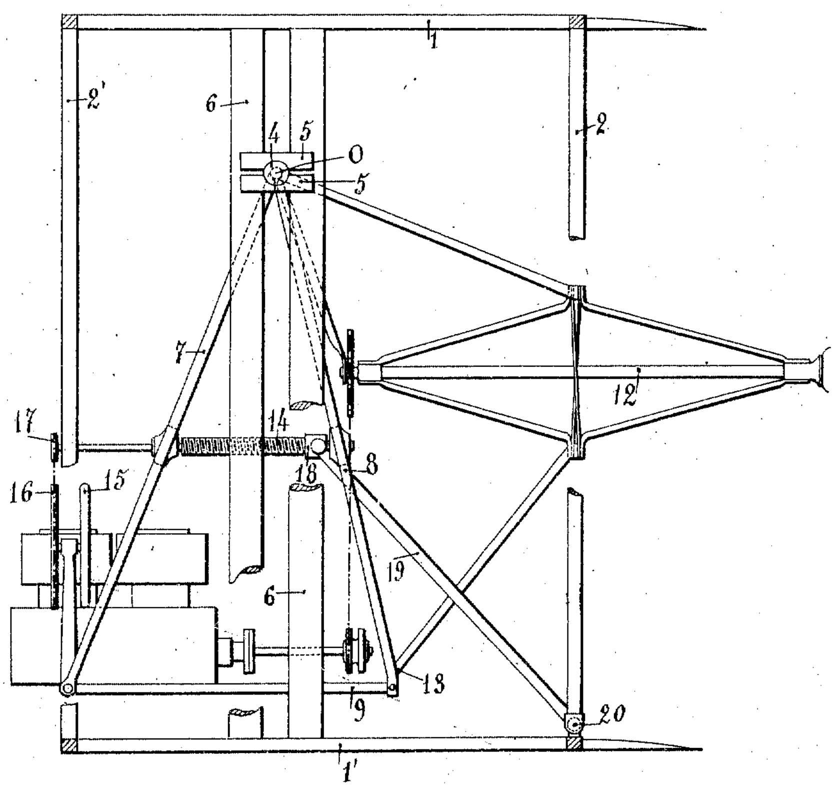
6 SHEETS—SHEET 4.

FIG_5_



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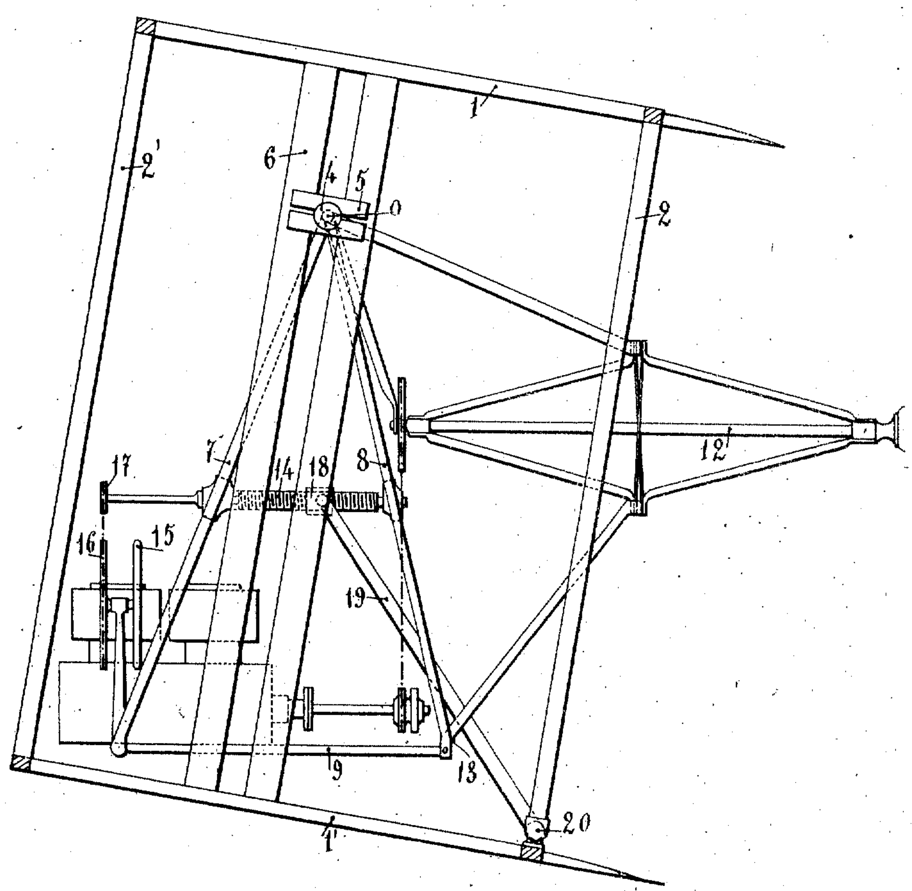
5 SHEETS—SHEET 5.

FIG _6_



Witnesses:-
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UNITED STATES PATENT OFFICE.

PAUL SCHMITT, OF PARIS, FRANCE.

AEROPLANE.

1,060,697. Specification of Letters Patent. Patented Aug. 15, 1911.

Application filed September 22, 1909. Serial No. 518,899.

To all whom it may concern:

Be it known that I, Paul Schmitt, engineer, citizen of the French Republic, residing at 18 Rue d'Edinbourg, Paris, France, have invented new and useful Improvements in and Relating to Aeroplanes, which improvements are fully set forth in the following specification.

This invention relates to an aeroplane in which means are provided for insuring longitudinal stability and guiding in the vertical direction, consisting of a device which always keeps the center of gravity of the system coincident vertically with the center of pressure whatever may be the incidence of the supporting planes; thus obtaining stability in a longitudinal vertical plane without the necessity of having recourse to a tail for insuring stability or to a vertical steering plane or elevator.

An aeroplane of any kind in motion is equilibrated when the center of gravity of the apparatus is vertically under the center of pressure. If the aeronaut varies the incidence of the planes on the line of flight (for example by means of the horizontal rudder) the center of pressure is shifted, the center of gravity is no longer vertically under the center of pressure, the equilibrium of the aeroplane is destroyed and may cause it to fall.

In carrying out this invention, the motor, the propellers, the controlling apparatus, the ground wheels, the aeronaut and passengers, if any, in fact the whole of the heavy parts of the machine, are carried on a frame pivoted within the aeroplane, the supporting planes being negligible in weight compared with the weight of the frame.

The invention will be better understood by reference to the accompanying drawings, illustrating one embodiment of the inventive idea, and in which—

Figure 1 is a side view illustrating diagrammatically an aeroplane provided with two supporting planes; Fig. 2 is an elevation, Fig. 3 a plan, and Fig. 4 a side view of the apparatus; Fig. 5 is a side view on a larger scale; Fig. 6 is a side view similar to Fig. 5, but illustrating the relative arrangement of the parts when the supporting planes have been shifted to an angle of 10 degrees; and Fig. 7 is a perspective view, illustrating the means by which movement in a horizontal plane is effected.

Referring to Fig. 1, A B and C D indicate two supporting planes of equal area arranged in a horizontal position (that is to say, at zero incidence, the line of flight being assumed to be horizontal). The position of the center of pressure being given by the formula,

$$d=(0.2+0.3 \sin. X) L$$

in which d is the distance from the front edge where lies the center of pressure P for the incidence x in the plane of depth L; the center of pressure for the incidence zero will thus be at P half way between the two planes A B and C D and at one fifth of the depth A B, that is to say at a distance P E, equal to

$$\frac{A B}{5}$$

from the line A C joining the two front edges of the supporting planes. If the propulsion frame be placed between the two planes, in such a manner that its center of gravity is at G on the vertical line P G, the aeroplane will be equilibrated in this position of its planes. If now it be supposed that all the incidences that will be utilized, alike in supporting the aeroplane at different velocities, according to the load on it, as well as for raising it, lie between zero and 18°, to each angle comprised between these two limits there is a corresponding new position of the center of pressure on the line P P′ parallel to the two supporting planes and at equal distance from each of them. The formula:

$$d=(0.2+0.3 \sin. 18°) L$$

gives the distance E P′, which enables the position P′ of the center of pressure for the incidence 18° to be determined.

Now if the propulsion frame ~~represented~~ by its center ~~of gravity~~ be displaced between ~~the two~~ supporting surfaces, on the line G G′ parallel to the surfaces and in the vertical plane, in order that the aeroplane may be equilibrated when the surfaces form an angle of incidence of 18° to the line of flight, the center of gravity G must be at G′ so that G′ P′ lies obliquely to the line P G, meeting it again at V and forming with it an angle of 18°, the straight line V P′ being the vertical line of the center of pressure for the incidence 18°. ~~Now if as~~ before the position of the center of pressure for the incidence of 9° be determined the formula will give: d=E P_1 and it will be found that P P_1 is approximately equal to

$$\frac{P\ P'}{2}$$

If P_1 V_1 makes an agle of 9° with P G′, its intersection with G G′ will give the new position for the center of gravity G_1. The triangles V G G′ and V_1, G G_1, being solved and the lengths G G_1 and G G_1' being given it will be found that

$$G\ G_1=\frac{G\ G'}{2}$$

approximately.

If the incidences be made to vary from degree to degree, the same operations being effected in each case, it will be found that the displacements of the centers of gravity and of pressure on the straight lines G G′ and P P′ are respectively proportional to the angles described, that is to say, the center of gravity always being vertical to the center of pressure, if for an angle x, 1 be the path through which the center of gravity should go on G G′ in order to satisfy the condition of equilibrium, the path traversed for an angle nx will be n^1.

It is necessary now to find the radius R of a circle in which the arc G G′ subtends an angle of 18° at the center. By drawing G O G′ O to meet the vertical line G_1 O—G_1 being the mid point of G G′— and so as to make the angle G O G′ equal to 18°, the length R, equal to O G_1, is found.

Supposing that the propulsion frame placed at G_1 is pivoted at the point O and describes an arc of 9° in the suitable direction, its center of gravity can be brought to the point g. In this position the propeller is placed horizontally on the frame. It follows that if at the same time the frame and the aeroplane be acted on by a suitable mechanical system of control it will be possible to cause the aeroplane to pivot around an axis placed at O; the center of gravity will pass through the arc g G_1 g'; no account being taken of the negligible differences between this arc and its tangent G G′ it will be seen that for all the incidences comprised between 0° and 18°, the center of gravity will always be vertical to the center of pressure, the line of propulsion remaining horizontal in all cases. In this way an aeroplane is obtained which has all the qualities for insuring its guidance in the vertical plane and its longitudinal stability without recourse to an elevator or to a tail.

The controlling device may evidently be of any kind, but it is carried out in a suitable way as described below with reference to Figs. 2, 3, 4, 5, 6 and 7 of the accompanying sheets of drawings. As will be seen from these figures which relate to a biplane, the supporting planes consist of two parallel surfaces 1, 1′ of canvas stretched over the upper and lower faces of a rectangular prismatic frame the parts of which are joined together by parallel uprights 2, 2′ joined by tension wires 3. The whole of this frame forms a rectangular parallelepiped which can pivot around a shaft 4, which runs exactly through the point O determined as has been stated in relation to the diagrammatic Fig. 1 and which is perpendicular to the plane of vertical symmetry of the aeroplane. The whole supporting device thus formed is mounted on this shaft 4 by means of bearing blocks 5 arranged on uprights 6 made of wood or any other suitable material; these uprights 6 are firmly fixed to the supporting device and pass from one plane to the other, being supported in central ribs in the supporting planes. On the shaft 4 is suspended the frame carrying the motor, the propellers, the controlling device, the passenger's seats, in a word all which does not form a supporting surface in the aeroplane. This construction is mounted on a frame formed by three triangular arrangements of tubes 7, 8, 9, 7′, 8′, 9′, 7″, 8″, 9″ (Fig. 7) firmly connected by suitable cross pieces and directly supporting the motor and the controlling apparatus. The triangles 7, 8, 9, 7′, 8′, 9′, etc., are rigidly fixed at 10, 10′, 10″ on the shaft 4 which assists in their cross connection. At 11 in the ends of the shaft 4 other triangular frames are also rigidly fixed these serving to support the shafts 12 carrying the propellers, these frames being connected at 13 and 13′, to the triangular frames 7, 8, 9, 7′, 8′, 9′. It will thus be seen that the propellers and the motor are fixed in a rigid frame fixed to the shaft 4 to which they are suspended while the system of supporting planes can pivot freely around this shaft 4. It will thus be seen that the incidence of the supporting planes can be modified as desired in relation to the axis of the propelling shaft of the aeroplane. The way in which these variations of inclination can be controlled has now to be described. On the middle triangular system 7″, 8″, 9″ parallel to the propeller shafts and at a suitable height a screw threaded shaft 14 is arranged, the movements of which are controlled by the aeronaut by means of a hand wheel 15 bearing the toothed wheel 16 connected by a chain to a pinion 17 mounted on the end of the screw threaded shaft. On to this shaft a nut 18 is screwed. This nut is furnished with pins on which are mounted the ends of the bars 19 which are pivotally connected at 20 with the foot of the central rear uprights 2 which connect the supporting planes. It will be readily seen from this that every movement of the nut 18 on the screw threaded shaft 14 will correspond to a movement of the points 20 the result of which will be to cause the whole supporting frame to turn around the axis of the shaft 4 and which will modify the inclination of the planes with relation to the axis of the propeller shafts.

If the length and the position of the screw threaded shaft have been determined in accordance with the idea illustrated in Fig. 1 in such a manner that a complete displacement of the nut 18 starting from the position indicated in Figs. 4 and 5 corresponds to an angle of 18° for the extreme positions of the uprights 6, it will be easily seen that by turning a hand wheel the aeronaut can place the supporting planes in relation to the axis of the propelling shaft, at any inclination comprised between zero and 18 degrees.

If with reference to Fig. 1 the distance from the point G to the center of gravity of the system have a length equal to R and if the movement of the nut on the screw-threaded shaft leads to a displacement of the center of gravity having the value of the length of the arc of 18°, then the center of gravity will always remain vertically under the center of pressure if care has been taken to place this center of gravity, for the position in Fig. 5, vertically under the center of pressure. It will be observed that in this method of realizing the means indicated already as a whole in relation to Fig. 1, the employment of a screw-threaded shaft assures the control being irreversible, which is essential in a controlled equilibrated device in which it is of importance that the aeronaut may be able to modify at will the incidence of the planes without its being possible for the constant connection between the center of gravity and the center of pressure when displaced in relation to a vertical line common to both to be destroyed at any time.

The whole construction, supporting planes and propulsion frame thus constitute at any moment a whole that cannot be put out of shape thanks to the application of irreversibility. The action of the operating wheel modifies the relative positions of the supporting device and of the propulsion device which then remain fixed in these relative positions; the equilibrium being constantly assured whatever the position.

Steering in the horizontal plane may be effected by any of the known methods, or by the method shown diagrammatically in Fig. 7. The struts 21, 22 (Figs. 3 and 7) at the front corners of the supporting planes serve as hinges for two vertical planes tapering rearward. The two lower rear corners are joined together by a cord 23 passing over suitably arranged pulleys and carrying in the middle a handle 24 or the like. When the aeroplane is started, the air in its passage between the two planes will keep the rear ends of the planes firmly pressed against the back uprights. In order to effect a change of direction in the horizontal plane it is only necessary to pull the rope so as to move one of the vertical planes from its normal position. This plane increases the air resistance on that side so that there is a slackening in the speed of this side of the aeroplane, while the other, increasing in speed, will cause the apparatus to turn. If the rope be released, the pressure of the air bringing the vertical plane to its first position, the aeroplane will resume a rectilineal direction.

With regard to the means for launching, with the apparatus just described, any of the systems at present in use, such as ground wheels, rails and pylon, etc. may be employed.

What I claim and desire to secure by Letters Patent is:—

1. In an aeroplane, a supporting surface, a load-carrying device pivoted to the framework of the aeroplane, and means for varying the angle of incidence of the supporting surface and moving said load-carrying device to maintain the centers of pressure and gravity of the aeroplane in the same vertical plane.

2. In an aeroplane, a supporting surface, a load-carrying device pivoted to the framework of the aeroplane, and means for varying the angle of incidence of the supporting surface and simultaneously moving said load-carrying device to maintain the centers of pressure and gravity of the aeroplane in the same vertical plane.

3. In an aeroplane, a supporting surface, a load-carrying device pivoted to the framework of the aeroplane, and a common means for varying the angle of incidence of the supporting surface and simultaneously moving said load-carrying device to maintain the centers of pressure and gravity of the aeroplane in the same vertical plane.

4. In an aeroplane, a supporting surface, a load-carrying device pivoted to the framework of the aeroplane, and means operated by the aeronaut for varying the angle of incidence of the supporting surface and moving said load-carrying device to maintain the centers of pressure and gravity of the aeroplane in the same vertical plane.

5. In an aeroplane, a supporting surface, a load-carrying device pivoted to the framework of the aeroplane, and a common means operated by the aeronaut for varying the angle of incidence of the supporting surface and moving said load-carrying device to maintain the centers of pressure and gravity of the aeroplane in the same vertical plane.

6. In an aeroplane, a supporting surface, a load-carrying device pivoted to the framework of the aeroplane, and a common means

operated by the aeronaut for varying the angle of incidence of the plane and simultaneously moving said load-carrying device to maintain the centers of pressure and gravity of the aeroplane in the same vertical plane.

7. In an aeroplane, a supporting surface, a load-carrying device pivoted to the framework of the aeroplane, and connections between said load-carrying device and framework for varying the angle of incidence of the planes and moving said load-carrying device to maintain the centers of pressure and gravity in the same vertical plane.

8. In an aeroplane, a supporting surface, a load-carrying device pivoted to the framework of the aeroplane, and connections between said load-carrying device and framework for simultaneously varying the angle of incidence of the surface and moving said load-carrying device to maintain the centers of pressure and gravity in the same vertical plane.

9. In an aeroplane, a plurality of supporting surfaces, a load-carrying device pivoted to the framework, a propeller, bearings therefor connected to said load-carrying device, and means for modifying the inclination of the supporting surfaces with relation to the axis of the propeller shaft and moving said load-carrying device to maintain the centers of pressure and gravity in the same vertical plane.

10. In an aeroplane, a plurality of supporting surfaces, a load-carrying device pivoted to the framework, a propeller, bearings therefor connected to said supporting device, and means for modifying the inclination of the supporting surfaces with relation to the axis of the propeller shaft and simultaneously moving said load-carrying device to maintain the centers of pressure and gravity in the same vertical plane.

11. In an aeroplane, a plurality of supporting surfaces, a load-carrying device pivoted to the framework, a propeller, bearings therefor connected to said load-carrying device, and common means operated by the aeronaut for modifying the inclination of the supporting surfaces with relation to the axis of the propeller shaft and moving said load-carrying device to maintain the centers of pressure and gravity in the same vertical plane.

12. In an aeroplane, a plurality of supporting surfaces, a load-carrying device pivoted to the framework, a propeller, bearings therefor connected to said load-carrying device, and common means operated by the aeronaut for modifying the inclination of the supporting surfaces with relation to the axis of the propeller shaft, and simultaneously moving said load-carrying device to maintain the centers of pressure and gravity in the same vertical plane.

13. In an aeroplane, a plurality of supporting surfaces, a load-carrying device pivoted to the framework, and a nut and screw connection between said load-carrying device and the framework operative to simultaneously vary the angle of incidence of the surfaces and move said load-carrying device to maintain the centers of pressure and gravity in the same vertical plane.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

PAUL SCHMITT.

Witnesses:
H. C. COXE,
DOUMÉ CASALONGA.