March 29, 1938. E. J. H. BILLIOQUE 2,112,757

STABILIZING DEVICE FOR AEROPLANES

Filed May 21, 1936 5 Sheets-Sheet 1

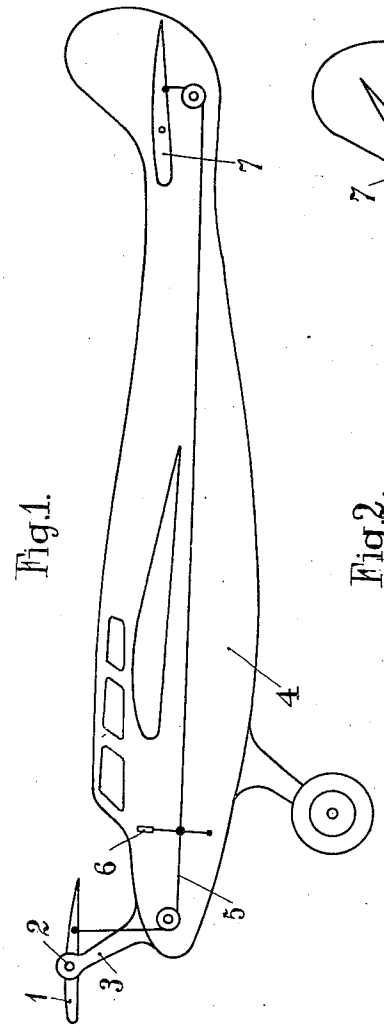


Fig.1.

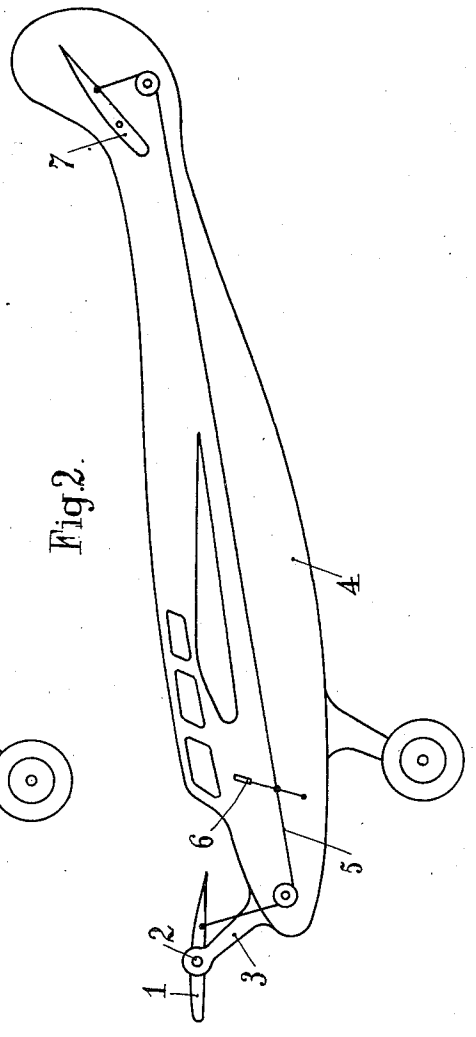


Fig.2.

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STABILIZING DEVICE FOR AEROPLANES

Filed May 21, 1936 5 Sheets-Sheet 2

Fig.3.

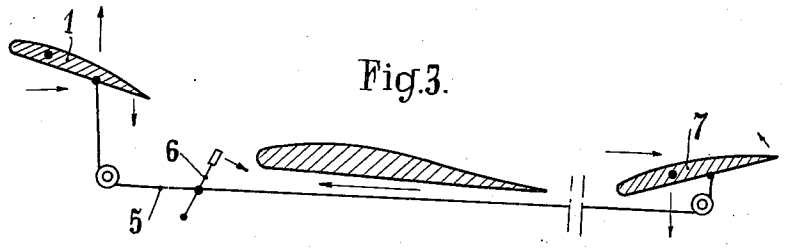


Fig.4.

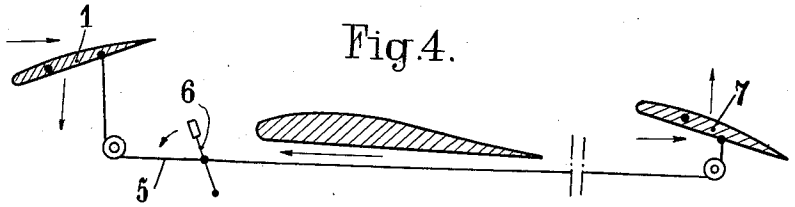
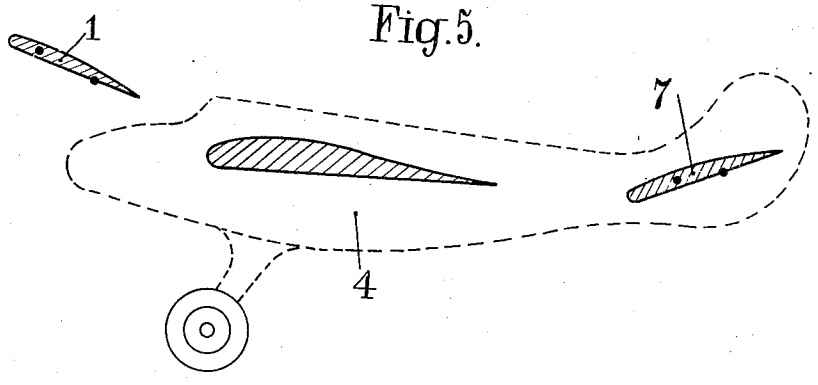


Fig.5.



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STABILIZING DEVICE FOR AEROPLANES

Filed May 21, 1936 5 Sheets-Sheet 3

Fig.6.

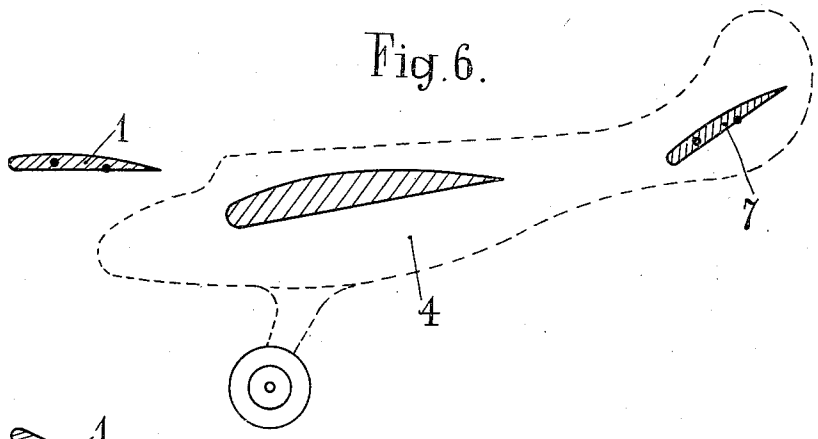


Fig.7.

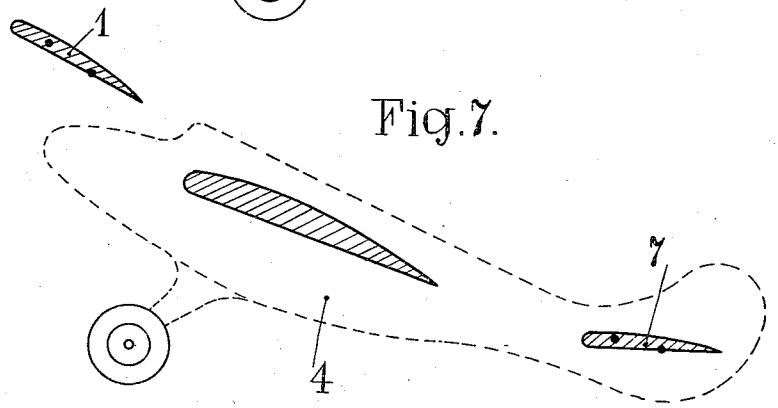
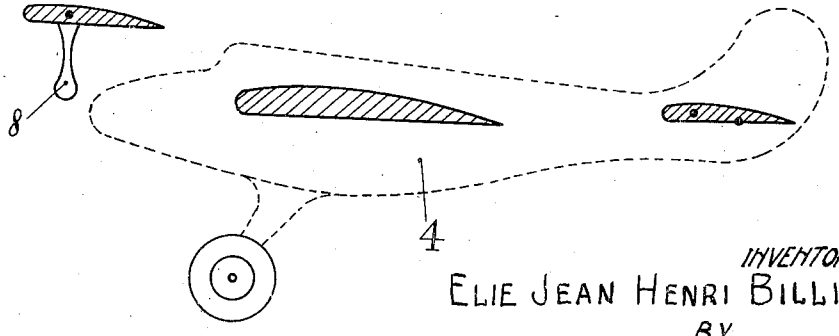


Fig.8.



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March 29, 1938. E. J. H. BILLIOQUE 2,112,757

STABILIZING DEVICE FOR AEROPLANES

Filed May 21, 1936 5 Sheets-Sheet 4

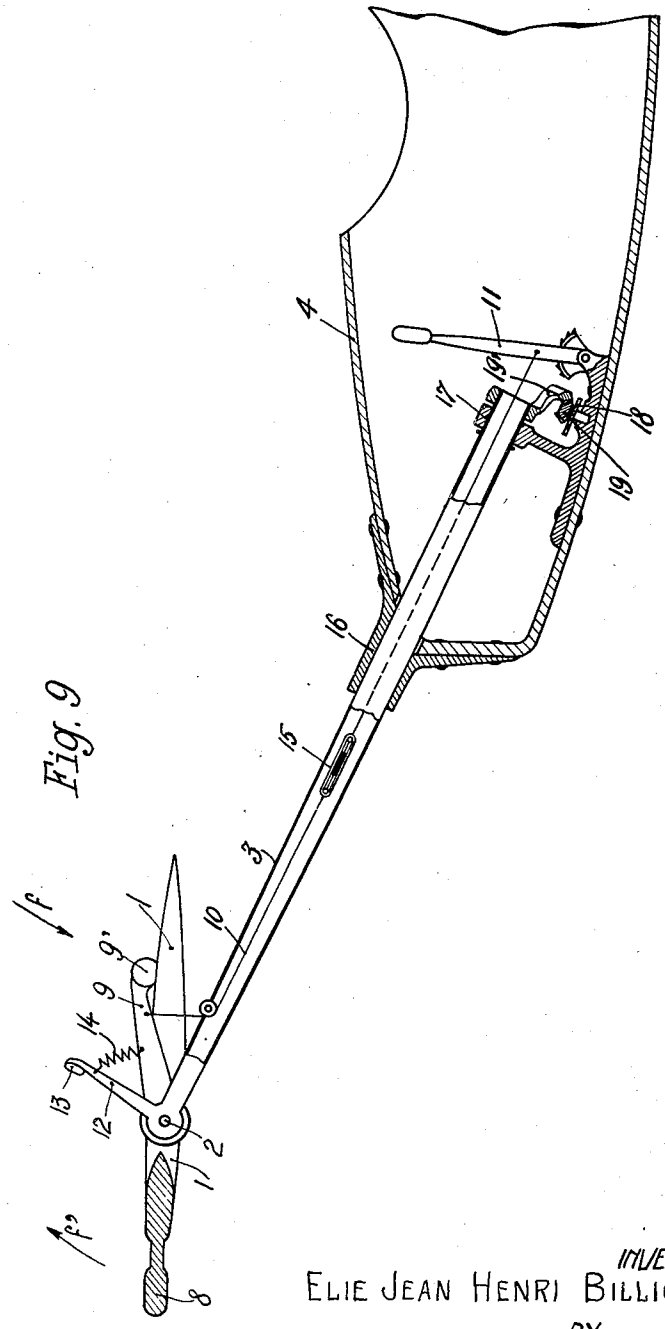


Fig. 9

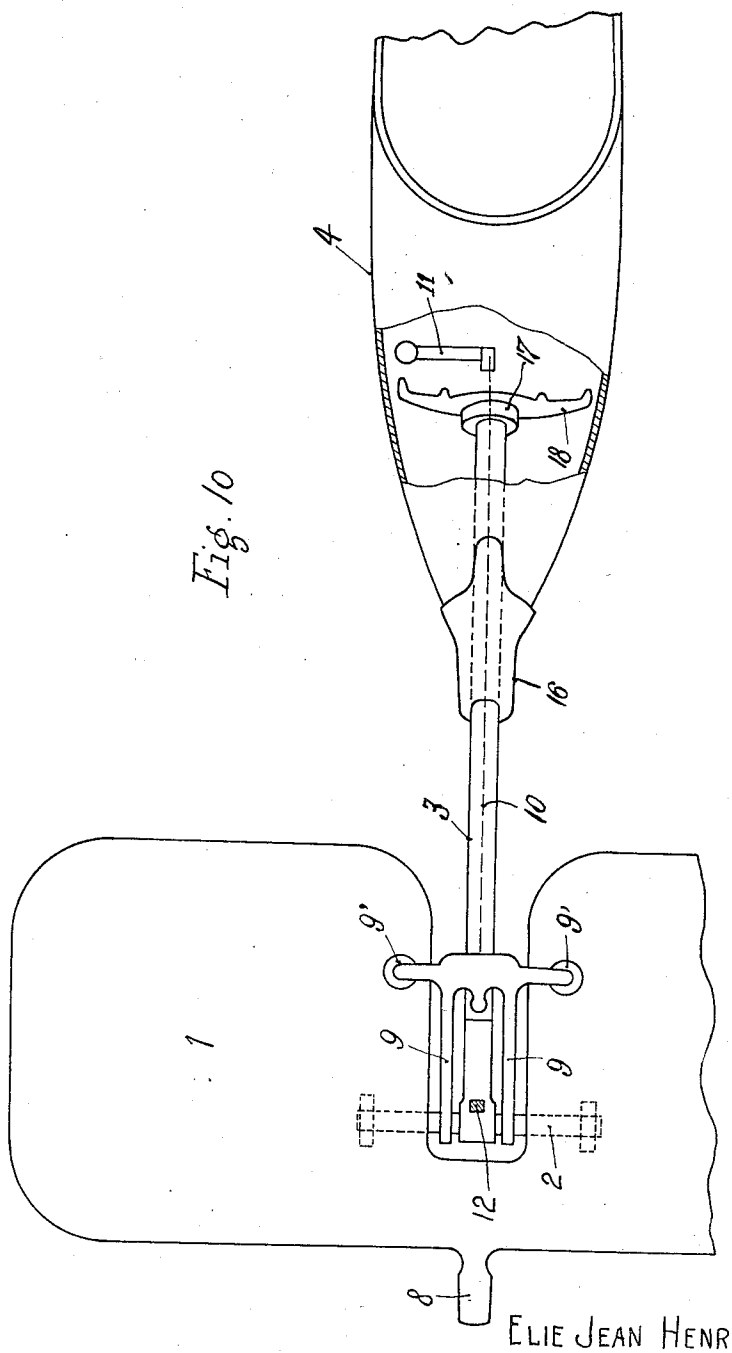
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Filed May 21, 1936 5 Sheets-Sheet 5

Fig. 10



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UNITED STATES PATENT OFFICE

2,112,757

STABILIZING DEVICE FOR AEROPLANES

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Application May 21, 1936, Serial No. 81,107
In France March 3, 1935

7 Claims. (Cl. 244—76)

It is well known that the principal disadvantages with aeroplanes constructed in the usual manner consists in the "loss of speed" which prevents flights at slow speeds and a vertical descent and which involves landings at dangerous speeds.

The loss of speed which should be called the "effect of the loss of speed" is the tilting movement which the aeroplane undergoes when its speed becomes too slow for the wing to have any supporting action. At this moment the aeroplane falls towards the ground at high speed as it is acted upon by gravity and does not offer any surface to the resistance of the air but only the edge of the wing.

Such an effect as the "loss of speed" is caused by the asymmetry of the resistance encountered by the rear supporting surfaces with respect to that encountered by the wing. When the aeroplane descends vertically (the motor having stopped for example and the effective speed being zero) the wing—which under the effect of the total weight which it carries descends quicker than the rear plane which does not bear any weight—falls more freely still as the arm of the lever formed by the rear part of the fuselage is relatively long.

The subject of the present invention is a device for avoiding this asymmetry and which is applicable to any type of machine. In this way when the aeroplane descends more or less vertically the fuselage encounters in front a resistance which is equal to that encountered at the rear. As the rear resistance has thus been compensated the fuselage has no inclination to fall. The aeroplane can therefore make a parachute descent and move at any speed without becoming unstable.

The device forming the subject of the invention consists essentially of a compensating plane, in one or more parts, disposed in the front of the machine, similar to the rear plane and controlled in such a way that it will be neutral when the aeroplane is following its normal line of flight but will come into operation as soon as the aeroplane reduces its speed in order to descend more or less vertically. This compensating plane may be controlled automatically or by the pilot and in the latter case in conjugation or not with the control of the rear plane or in conjugation or not with the automatic control of the said compensating plane.

The invention moreover comprises a particular construction of abutments disposed on either side of the compensating plane, in order to maintain the freedom of action of the plane between fixed limits, as well as means enabling the pilot to control his direction in the vertical descents which can be obtained with this device.

It will be understood that the two improvements mentioned above can be used separately or in combination.

Reference will now be made to the accompanying drawings and in which:—

Fig. 1 shows, in a horizontal flight, an aeroplane provided with the device in question connected mechanically to the tail plane,

Fig. 2 shows the position taken up by the device when the aeroplane has no longer any effective speed,

Figs. 3, 4, 5, 6, and 7 are schematic views illustrating the method of operation of the device,

Fig. 8 shows a modified form of the device,

Fig. 9 is a sectional view of the front of an aeroplane provided with the improvements in question,

Fig. 10 is a partial plan view of Figure 9.

In the form of construction shown in Figures 1 and 2 the compensating plane which has been given the highest position is shown at 1. This compensating plane which is statically balanced is pivotally mounted at 2, on a support 3 fixed to the front of the aeroplane 4. The pivotal point 2 of the compensating plane is preferably slightly in advance of the centre of thrust so that the said plane does not get out of control but tends to place itself in the wind in the manner of a weathercock. A mechanical connection, for example a cable 5, connects the rear part of the plane to the controlling device 6 of the aeroplane which is connected to the tail plane 7 in the known manner. Under these conditions when the rear part of the tail plane 7 is depressed, the rear part of the front plane is raised and vice versa.

In view of the fact that the plane 1 must be able to freely place itself in the wind during normal flight of the aeroplane, the strand of the cable 5 in the case in which it is connected to the handle of the controlling device 6 must remain inactive under normal circumstances and only have an action on the plane when the handle occupies its extreme rear position corresponding precisely to an abnormal condition of flight which is caused by loss of speed. In other words, in normal flight the action of the pilot should not in any way influence the plane 1 which is free.

In order to understand the operation of the

device according to the invention, reference will be made to Figs. 3, 4, 5, 6, and 7.

In the optional case where the abutment is connected to the control handle, during flight when the rear plane 7 is raised, there is a tendency to make the aeroplane rise (Fig. 3). By the same movement, when the slack of the part of cable 5 connecting plane 1 to the handle ceases to exist, the front plane 1 is lowered and there is also a tendency to make the aeroplane rise. There is thus the combination of two planes to obtain a lifting motion.

The reverse movement (Fig. 4) allows the aeroplane to descend. As a result of the lowering of the rear plane 7, the front plane 1 remains free to place itself in the wind by reason of the play of the part of the cable 5 connecting this plane to the control handle 6.

In the respective position of the three wing and plane elements shown in Fig. 5 (front plane 1 and rear 7 in a symmetrical V with respect to the wing) the result is as follows:—

When the aeroplane no longer has any effective horizontal movement (an extreme case) it is acted on entirely by gravity and tends to descend vertically.

If the aeroplane has a tendency to incline downwards (Fig. 6) in obtaining its equilibrium the front plane 1 presents a greater surface to the air than the rear plane. Consequently it resists and checks the descent more than the rear plane and thus opposes the tendency of the plane to tilt downwards.

Conversely if the aeroplane has a tendency to rise (Fig. 7) it is the rear plane 7 which offers more resistance to the ascent since it presents a surface to the air and therefore opposes the tendency to ascend. The aeroplane is divided between these two tendencies (descending and ascending) and takes an intermediate horizontal position of equilibrium in its vertical descent.

For asymmetrical positions, with respect to the wing of the front plane 1 and the rear plane 7 the wing does not remain quite horizontal and the descent will be more or less oblique and will be the resultant of the respective tendencies of the wing, and the rear and front planes with, if anything a greater tendency of the aeroplane to advance in front (which is to be expected) as the centre of gravity is generally slightly in front of the centre of the section of the wing.

Moreover it will be seen that in the position in Fig. 6 when the aeroplane is on the point of landing, the front plane 1 encounters a mass of air which is more compressed between the earth and itself than between the earth and the rear plane, which tends to automatically straighten the aeroplane.

In the case of Fig. 8 the front plane is kept horizontal by a counterpoise 8 without conjugation of control with the rear plane 7. The same applies here as in the preceding case, but in addition whatever the position of the rear plane (a position which can only vary slightly) the front plane 1 always automatically opposes a descent which is too accentuated since the more the aeroplane descends the more the rear plane tends to become ineffective whilst the front plane always presents itself horizontally to any descending movement.

This automatic arrangement gives several advantages, for example if the pilot of the aeroplane is wounded or otherwise indisposed and unable to control the same. It is equally advantageous for trial prototypes or for models, which always have a tendency to descend too quickly and crash.

The said automatic mechanism must be combined with the conjugate control of the compensating plane 1 and the tail plane 7.

When the compensating plane is maintained horizontally by a counterpoise such as 8 the oscillations of this counterpoise can be reduced for example by means of a dashpot, gyroscope or other suitable stabilizing means.

An abutment must be provided above the plane 1 in such a way as to provide a support for this plane in a limited angular extent adjustable if necessary. The abutment below the plane is optional.

The counterpoise 8 or other device for maintaining a horizontal position (level with electrical contacts or gyroscopic level) may be disposed at any suitable point in the apparatus and can control the plane at a distance, by a mechanical connection or the like instead of a direct control.

Whether the plane 1 is controlled automatically or not it must have a certain margin of liberty of movement which will enable it to place itself automatically in the wind.

Referring more particularly to Figs. 9 and 10 it will be seen that 1 refers to the compensating plane described above mounted freely about an axle 2 parallel to the mean axis of the wings, perpendicular to the axis of the fuselage. This axle is mounted at the end of a support such as 3.

The free plane 1, maintained statically horizontal by means of a counterpoise such as 8, may be limited in its angular displacements under the action of a current of air by means of an arm 9 which may be mounted on the axle 2 and comprising abutments 9' at its rear extremity. This arm 9 may be controlled by the pilot by means of a cable 10, which in turn may abut on a lever 11, whose movement permits of moderating or increasing the movement to be applied to the front of the plane 1.

On the other hand the support 3 is provided at its free extremity with a lever 12 terminating in an arm 13 to stop the upper front surface of the plane 1 if a current of air coming from behind in the direction of the arrow *f* for example (Fig. 9) has the effect of returning this plane in the direction of the arrow *f'*. The arm 9 is connected to the arm 12 by means of a return spring 14.

The abutments 9' and 13 are preferably provided with elastic material or a spring device in order to reduce shock on the plane 1.

The cable 10 mentioned above may have a sandow or spring such as 15 incorporated therein in such a way that it will start to give if the force of the current of air on the lower face of the plane 1 exceeds a certain value. Under these conditions the said plane 1 will move so as to give no resistance in the presence of an abnormal pressure.

In order to understand the action of the device forming the subject of the second improvement mentioned above an aeroplane descending vertically and in a horizontal position will be considered. It will be understood that the controls will not act in the same manner as with a horizontal flight. In particular the vertical rudder no longer has any effect and the direction of the aeroplane results from the helical form of the assembly of planes which, if it is not void, puts the aeroplane into a spiral in accordance with this helical assembly.

In order to remedy this fault the helical turning action is compensated by another helical action controlled by the movement of the vertical rudder. This controlled helical action can equal and if necessary exceed the first according to what effect is desired.

For this effect the support **3** of the compensating plane turns freely in the bearings **16** and **17** fixed to the front part of the fuselage.

It will be understood that under the action of the double lever **18** (which controls the vertical rudder in the normal manner) engagement of the angle piece **19** fixed to this double lever engages a toothed sector of the angle piece **19'** fixed to the support **3**, this support **3** rotating and, by means of the axle **2**, will incline the plane **1** to the right or left with respect to the mean plane of the wings. The effect of this will be the creation of a new, more or less pronounced helical action of the plane assembly so that the pilot will be able to control the turning of the aeroplane or to keep it in a straight line.

It will be understood that the same effect can be obtained with a similar combination of the tail plane. This effect could be increased by conjugating the inclination of the front plane and that of the rear plane, in inverse directions.

It will be understood that the forms of construction described above do not limit the invention and may be modified in practice without departing from the spirit of the invention.

I claim:

1. In an aeroplane having a fuselage, a supporting wing and a rear horizontal plane, a stabilizing device adapted to permit vertical descent of the aeroplane to land without influencing longitudinal flight, comprising a compensating plane disposed at the front of the aeroplane, means for mounting said plane for free pivoting movement within predetermined limits so that said plane may place itself in the wind and remain inoperative when the aeroplane follows a line of normal flight but so that said plane becomes operative when the aeroplane loses speed, and a fixed abutment for supporting said plane in a determined maximum angular position.

2. In an aeroplane having a fuselage, a supporting wing and a rear horizontal plane, a stabilizing device adapted to permit vertical descent of the aeroplane to land without influencing longitudinal flight, comprising a compensating plane disposed at the front of the aeroplane, means for mounting said plane for free pivoting movement within predetermined limits so that said plane may place itself in the wind and remain inoperative when the aeroplane follows a line of normal flight but so that said plane becomes operative when the aeroplane loses speed, and an adjustable abutment for supporting said plane in a determined maximum angular position.

3. In an aeroplane having a fuselage, a supporting wing and a rear horizontal plane, a stabilizing device adapted to permit vertical descent of the aeroplane to land without influencing longitudinal flight, comprising a compensating plane disposed at the front of the aeroplane, means for mounting said plane for free pivoting movement within predetermined limits so that said plane may place itself in the wind and remain inoperative when the aeroplane follows a line of normal flight but so that said plane becomes operative when the aeroplane loses speed, an adjustable abutment for supporting said plane in a determined maximum angular position, an adjustable plane at the rear of said aeroplane, and means conjunctively connecting said adjustable abutment with said rear plane.

4. In an aeroplane having a rudder and a control therefor, a compensation plane disposed at the front of said aeroplane, a shaft for pivotally carrying said plane, a mast for supporting said shaft in a position substantially parallel to the axis of the main wings of the aeroplane, said plane being so mounted as to permit it to freely pivot about its axis and freely place itself in the wind and remain inoperative when the aeroplane follows its line of normal flight but becomes operative when the aeroplane loses speed, an abutment forming a support for the plane, a second abutment limiting downward movement of said plane about its pivot, means for mounting said mast for rotary motion about its axis, and means connecting said mast with the rudder control of the aeroplane to rotate said mast to incline the plane carried thereby relatively to the plane of the wings of the aeroplane to cause said aeroplane to move helically relative to an upward vertical current of air during vertical descent.

5. In an aeroplane having a fuselage, a supporting wing, a rear horizontal plane, and a horizontal transverse pitching axis, an equilibrium device permitting a vertical flat descent of the aeroplane, comprising a front auxiliary plane, means for mounting said front auxiliary plane for pivotal movement about a horizontal axle parallel to the pitching axis of the aeroplane and at the front of the aeroplane, said pivoted plane being pivoted in front of its center of pressure and statically balanced, said pivoted plane being also of such size and so positioned that the effort produced at the front of the fuselage by its resistance to an upward vertical current of air counter-balances exactly with respect to the pitching axis the effort produced by the resistance at the rear of the fuselage by the rear horizontal plane in the same current of air, and means for limiting the upward movement of the rear of said pivoted plane so that the pivoted plane floats freely when the aeroplane is in steady flight but becomes operative and contacts with the said limiting means when the nose of the aeroplane drops as the result of a stall.

6. In an aeroplane having a fuselage, a supporting wing, a rear horizontal plane, and a horizontal transverse pitching axis, an equilibrium device permitting a vertical flat descent of the aeroplane, comprising a front auxiliary plane, means for mounting said front auxiliary plane for pivotal movement about a horizontal axle parallel to the pitching axis of the aeroplane and at the front of the aeroplane, said pivoted plane being pivoted in front of its center of pressure and statically balanced, said pivoted plane being also of such size and so positioned that the effort produced at the front of the fuselage by its resistance to an upward vertical current of air counter-balances exactly with respect to the pitching axis the effort produced by the resistance at the rear of the fuselage by the rear horizontal plane in the same current of air, means for limiting the upward movement of the rear of said pivoted plane so that the pivoted plane floats freely when the aeroplane is in steady flight but becomes operative and contacts with the said limiting means when the nose of the aeroplane drops as the result of a stall, said mounting means including an arm projecting in front of the fuselage and mounted for rotary movement, and means for rocking said arm to in-

cline the front auxiliary plane with respect to the plane of the supporting wing of the aeroplane.

7. In an aeroplane having a fuselage, a supporting wing, a rear horizontal plane, and a horizontal transverse pitching axis, an equilibrium device permitting a vertical flat descent of the aeroplane, comprising a front auxiliary plane, means for mounting said front auxiliary plane for pivotal movement about a horizontal axle parallel to the pitching axis of the aeroplane and at the front of the aeroplane, said pivoted plane being pivoted in front of its center of pressure and statically balanced, said pivoted plane being also of such size and so positioned that the effort produced at the front of the fuselage by its resistance to an upward vertical current of air counter-balances exactly with respect to the pitching axis the effort produced by the resistance at the rear of the fuselage by the rear horizontal plane in the same current of air, means for limiting the upward movement of the rear of said pivoted plane so that the pivoted plane floats freely when the aeroplane is in steady flight but becomes operative and contacts with the said limiting means when the nose of the aeroplane drops as the result of a stall, and means for adjusting the position of said limiting means to vary the degree of movement of said auxiliary plane about its axle.

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