P. L. A. REGNARD.

AUTOMATIC STABILIZER FOR AEROPLANES AND THE LIKE.

APPLICATION FILED AUG. 24, 1910.

1,015,837.

Patented Jan. 30, 1912.

4 SHEETS—SHEET 1.

Fig. 1.

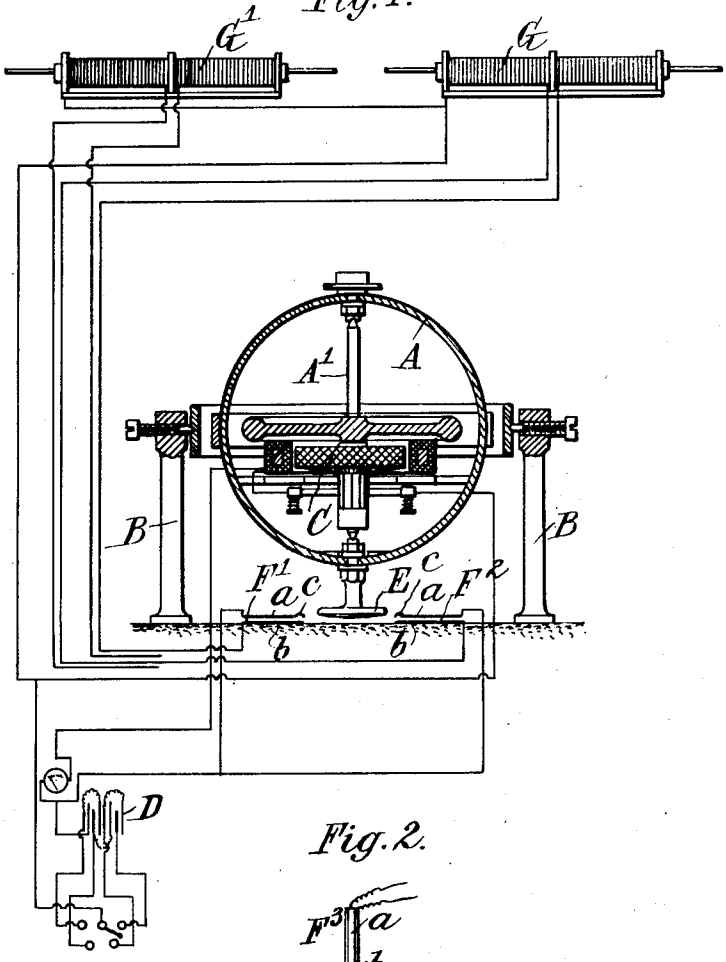

Fig. 2.

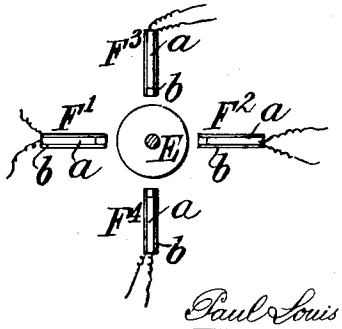

Fig. 3.

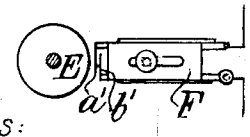

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Fig. 4.

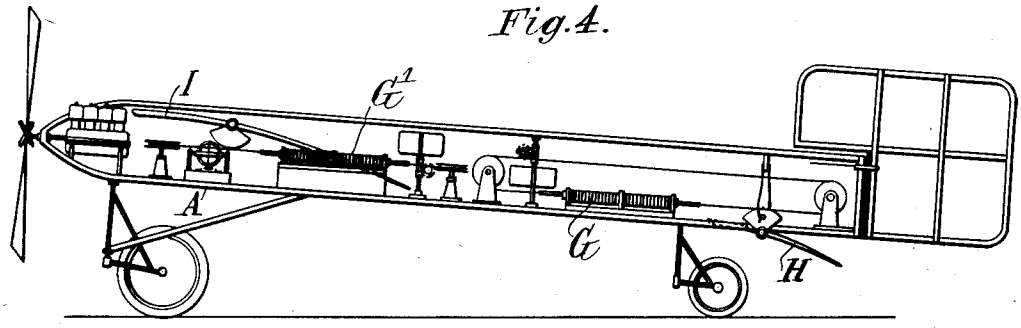
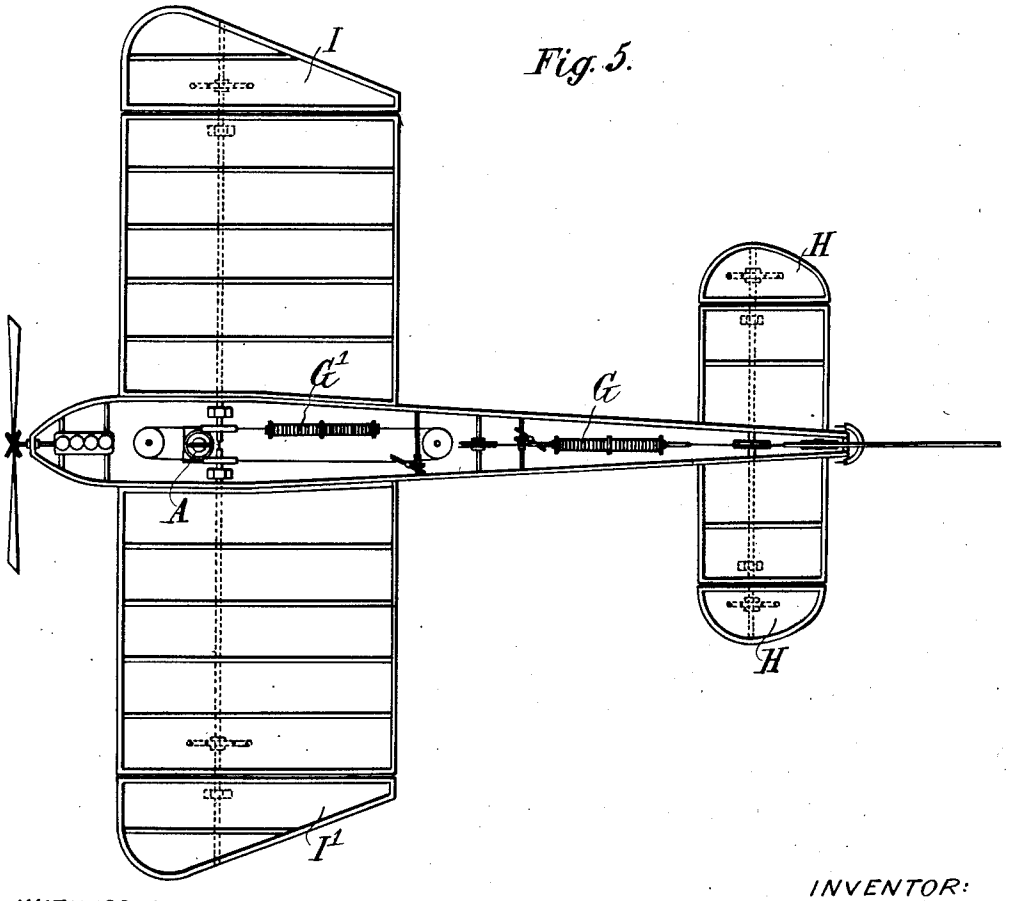


Fig. 5.



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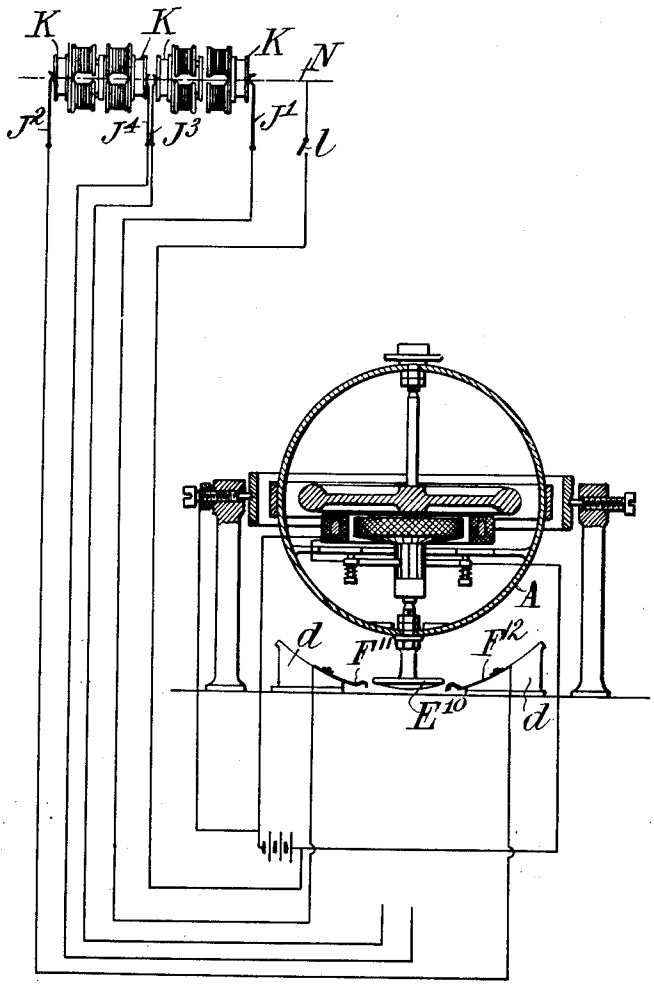
4 SHEETS—SHEET 3.

Fig. 6.



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4 SHEETS—SHEET 4.

Fig. 11.

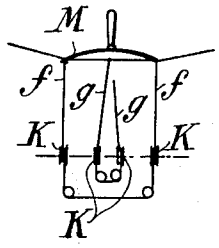


Fig. 7.

Fig. 12.

Fig. 10.

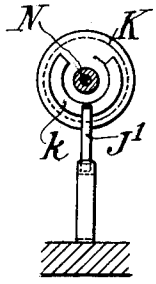


Fig. 8

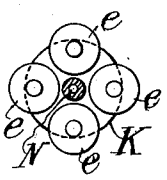
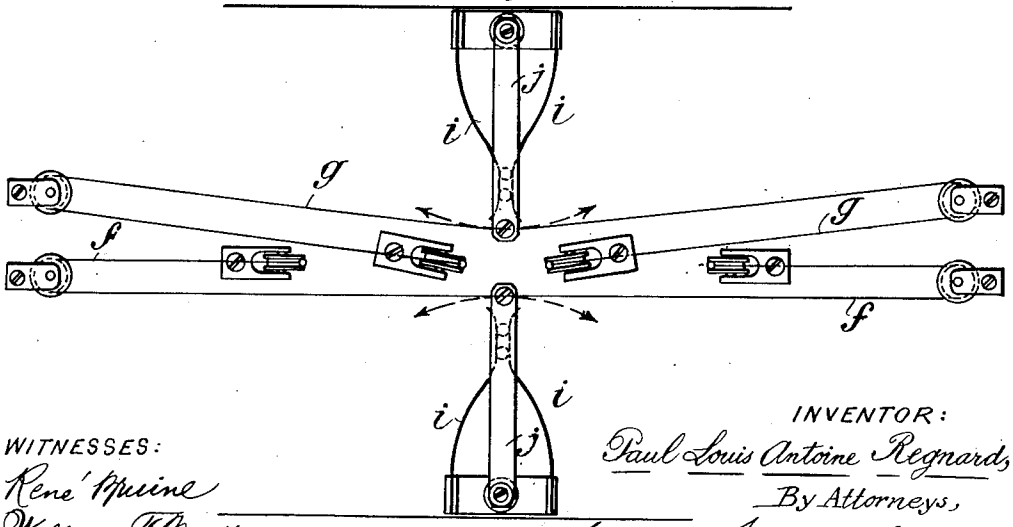


Fig. 9.



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UNITED STATES PATENT OFFICE.

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AUTOMATIC STABILIZER FOR AEROPLANES AND THE LIKE.

1,015,837. Specification of Letters Patent. Patented Jan. 30, 1912.

Application filed August 24, 1910. Serial No. 578,711.

To all whom it may concern:

Be it known that I, PAUL LOUIS ANTOINE REGNARD, a citizen of the Republic of France, and a resident of Paris, France, have invented certain new and useful Improvements in Automatic Stabilizers for Aeroplanes and the Like, of which the following is a specification.

The most essential point in the operation of aeroplanes is to maintain complete stability in all directions and this requires the greatest care and constant attention on the part of the aviator, who is obliged to be constantly watching the horizon and avoiding the least distraction which might overturn his machine.

The object of the present invention is to maintain automatically the stability of aeroplanes in particular, or other air vessels generally, by means of the constancy of the plane of a gyroscope in rapid rotation. The constancy of this plane is made use of to control electrically, in any convenient manner, the balancing members of an aeroplane, so that the aviator need not concern himself with the stability of the machine, since the gyroscopic system takes his place and plays the part of an artificial mechanical instinct, similar to the reflex brain action of birds and insects.

The accompanying drawings illustrate the principle of the invention and means for carrying it out.

Figure 1 is a longitudinal section of a gyroscope system, with an arrangement of the connections for controlling the balancing members of the aeroplane. Figs. 2 and 3 show details of construction of the apparatus. Figs. 4 and 5 represent respectively, on a small scale, a longitudinal axial section and a plan of a monoplane aeroplane provided with this gyroscopic system, and with electric control by means of solenoids. Fig. 6 shows an installation with electric winding drums. Fig. 7 shows by way of example the application of the winding drums to the automatic control of a universal control frame of the "Bleriot" system connected to the stabilizing members. Figs. 8, 9 and 10 show details of this construction. Figs. 11 and 12 are two views showing diagrammatically the connection between the winding drums and the universal control frame.

The apparatus for maintaining the stability consists essentially of the gyroscope A suspended by a Cardan joint from the two supports B which are integral with the chassis of the aeroplane. Motion is given to the gyroscope by a little electric motor C driven by a battery of accumulators. With the high speed that can be obtained in this way the axis A′ of the gyroscope will always remain in the vertical plane and with it the disk E. The object of the latter is to complete electrical circuits by means of the contacts F which can be adjusted according to the sensitiveness which is required for the apparatus and which each control one or more balancing members of the aeroplane. Each of the contacts F can consist, as is shown in Figs. 1 and 2, of two superposed conducting strips *a* and *b*, the upper strip *a* carrying an arched projection *c* on which the disk E rests by the lower portion which is rounded off so that its surface is spherical and the radius of the sphere is the distance from the center of the gyroscope axis. In this way if the balance is destroyed the disk E bends the strip *a* and causes it to make contact with *b* and to complete the corresponding circuit leading to one of the solenoids G G′, which solenoids are provided with two windings adapted to operate the armature thereof in opposite directions according to the contact closed by the disk E. This arrangement (shown in Figs. 1 and 2) has the merit of causing a constant pressure to be applied to the contacts whatever may be the inclination of the apparatus. Each contact might consist of the two strips *a′ b′* (Fig. 3) which might be brought into contact by the pressure due to the disk E; but this pressure would not be constant and would increase with the inclination of the aeroplane. Or again the contact could be made by a single strip (as shown for instance in Fig. 6) which would complete the circuit by means of E^{10} which in that case would be a conducting metal and in electrical connection with one side of the source of electricity.

If the aeroplane is inclined, the disk E, (Figs. 1 and 2) whose axis as explained above is always vertical, rests momentarily on the strip *a;* this makes contact with the lower strip *b* and the circuit which is closed in this way can be used for the control of one of the balancing members of the aeroplane, or for a combination of these same members, either through small electric winding drums, (Fig. 6) or as is shown in

Figs. 1, 4 and 5, by means of solenoids. In the latter case, if we suppose that the disk E can be displaced relatively to four contacts, two F′, F² for the longitudinal stability of the aeroplane and two others F³, F⁴ for the transverse stability, it will be necessary to employ two double-wound solenoids G′ and G² for each pair of opposite contacts, which contacts of each pair control the machine in opposite directions in the same plane of stability. When for instance a gust of wind or other circumstance causes the fore part of the apparatus to dip, the disk E would close the contact F′ and the rear planes H of the aeroplane (Figs. 4 and 5) would be inclined downward toward the front portion under the action of the solenoid G and suitable connections such as a sector and pulley and ropes. If on the other hand, the front part of the apparatus rises, the planes H are raised through the closing of contact F² and the action of the solenoid G, the solenoid being excited in the opposite direction to that in the previous case when contact F′ was closed, by reason of its double winding. In the same way if the apparatus is inclined to one side or the other, the contacts F³ and F⁴ and the solenoid G′ will reestablish the transverse equilibrium by means of the combined movement of the lateral balancing planes I and I′ which act respectively in opposite directions.

When the small winding drums are used, as shown in Fig. 6, the disk E¹⁰ of the gyroscope A which is always in the vertical plane, is preferably made of a conducting metal and makes contact, which the apparatus is inclined, with one or other of the four strips F¹¹, F¹², etc., which are rigidly mounted on the curved support *d*, whose center of curvature coincides with that of the gyroscope so as to obtain a very accurate adjustment. Each strip F¹¹, F¹² is connected with a brush J′, J², J³, J⁴, which is always in contact with a drum K carrying a series of electromagnets *e* (Figs. 7 and 8). A disk L is arranged between each pair of groups of electromagnets and this disk is attached to a central shaft N, which is kept constantly rotated by the main driving motor or in default of this by a little electric motor, which is set in action when the main motor stops so that the stabilizing effect of the gyroscope is always acting. Each disk L acts as armature to the two electromagnets, which are placed on each side of it, and it is obvious that if the current is sent around one of these electromagnets, which takes place when the disk E¹⁰ of the gyroscope makes contact with one of the strips F¹¹, F¹² . . . , this electromagnet will be drawn toward the disk L, set in rotation and will consequently turn the drum which it carries. If now this drum is connected for example to some point of a universal control frame M provided with a Cardan joint, such as used in the "Bleriot" aeroplanes for longitudinal and transverse balancing, it is easily understood that this frame will be pulled by the drums when they are set in action and will consequently set in action the appropriate stabilizing members to which it is connected.

To facilitate and simplify the control of the balancing planes two diametrically opposite points of the frame are connected together by an endless cord *f* which is used for the longitudinal stability and passes around two of the drums K so that one of the drums pulls the frame to one side, while the other tends to pull it to the opposite side. It is obvious that only one of these drums operates at a time, the other only follows the motion of the cord which is wound on it. Another endless cord *g* passes around two other drums K and is attached to the frame so as to bring about the transverse stability (Figs. 11 and 12). When the gyroscope energizes the two electromagnets at the same time, which occurs when the apparatus is inclined in two directions mutually at right angles, the two cords *f* and *g* act together on the frame M and reëstablish completely the equilibrium of the apparatus. When the equilibrium of the latter is perfectly reëstablished, the gyroscope contact disk E is removed from the different contacts F¹¹, F¹² . . . , and the electromagnets being no longer attracted by their armature L are pulled away from these latter by the action of little springs *h* fitted in naves and no longer act on the frame M. The springs *i* (Fig. 9) bring the frame back to its vertical position by means of the levers *j* attached to the cords *f* and *g*. These springs *i* need not necessarily be attached to the cords *f* and *g* of the frame but may be placed at any point of the transmission and even on the stabilizing members of the apparatus.

In order that the pull of the cords *f* and *g* of the winding drums on the frame M shall only take effect when the frame M and consequently the stabilizing members are in the position of maximum inclination, each of the brushes J′, J², J³ or J⁴ only closes the circuit of its electromagnet a time sufficient to cause the drum to rotate to the required extent. For this purpose the sector R on which the brush rests is given a suitable arc (Fig. 10).

This system of automatic control does not in any way interfere with the regulation by the aviator himself. On the handle M′ of the balancing frame there is a push contact *l* which allows the aviator to cut off the current through the contacts closed by the gyroscope and to use the balancing frame in the ordinary way. The automatic control of air ships by means of little winding drums

with electric engagement allows of a very gentle and gradual action on the balancing members and the speed of rotation of the armatures of the electromagnets can be very easily regulated. This gyroscopic system can evidently be applied to any aeroplane or other aeronautical apparatus of any kind and the control of the balancing members can be made through winding drums, solenoids or in other suitable manner, provided that a current of electricity is made use of which is established by the gyroscope and its contacts and the source of electricity may be the same accumulators which drive the gyroscope or some separate supply.

Having thus described the nature of my said invention and the best means I know of carrying the same into practical effect, I claim:—

1. In an aeroplane, the combination of stabilizing means, electrically operated means for actuating said stabilizing means, contacts on the longitudinal and transverse axis of the aeroplane and a gyroscope rotating in a vertical plane having a vertical projection around which said contacts are arranged, whereby tipping of the aeroplane causes the projection on said gyroscope to bear against said contacts and close the circuit through said electrically operated means to actuate said stabilizing means to right the aeroplane.

2. In an aeroplane, the combination of stabilizing means, electrically operated means for actuating said stabilizing means, four contacts at right angles to each other on the longitudinal and transverse axis of the aeroplane and a gyroscope rotating in a vertical plane having a vertical projection around which said contacts are arranged, whereby tipping of the aeroplane causes the projection on said gyroscope to bear against said contacts and close the circuit through said electrically operated means to actuate said stabilizing means to right the aeroplane.

3. In an aeroplane, the combination of lateral and vertical stabilizing means, solenoids for actuating said stabilizing means, contacts on the longitudinal and transverse axis of the aeroplane, and a gyroscope rotating in a vertical plane having a vertical projection around which said contacts are arranged, whereby tipping of the aeroplane causes the projection on said gyroscope to bear against said contacts and close the circuit through said solenoid to actuate said stabilizing means to right the aeroplane.

In witness whereof, I have hereunto signed my name in the presence of two subscribing witnesses.

PAUL LOUIS ANTOINE REGNARD.

Witnesses:
H. C. Coxe,
Jules Armengaud, Jeune.